MASTER

(Wiring diagrams)

144MHz FM TRANSCEIVER

IC-2A/AT/E

MAINTENANCE MANUAL

144MHz FM TRANSCEIVER

IC-2AT/E

MAINTENANCE MANUAL

TABLE OF CONTENTS

SECTION 1 SPECIFICATIONS

GENERAL

Number of Semiconductors	:	Transistors	43 (42) <41>
		FET	3
		IC	5 [6] (6)
		Diodes	21 (20)
Frequency Coverage	:	144.000 ~ 147.995MHz:	IC-2Au, IC-2Ao, IC-2AT, IC-2E$_I$
		144.000 ~ 145.995MHz:	IC-2E$_{DL}$
Frequency Resolution	:	5KHz steps 800 channels or 400 channels	
Frequency Control	:	Digital PLL synthesizer, with thumbwheel switches	
Frequency Stability	:	Within ±1.5KHz	
Usable Temperature	:	−10°C ~ 60°C (14°F ~ 140°F)	
Antenna Impedance	:	50 ohms unbalanced	
Power Supply Requirement	:	DC 8.4V; with attendant power pack IC-BP3, DC 6 ~ 12V negative ground is acceptable	
Current Drain at 8.4V	:	Transmitting	
		HIGH : 1.5W	Approx. 550mA
		LOW : 0.15W	Approx. 220mA
		Receiving	
		At max audio output	Approx. 130mA
		Squelched	Approx. 20mA
Dimensions	:	116.5mm (H) x 65mm (W) x 35mm (D) without power pack Attendant power pack, IC-BP3 49mm (H) x 65mm (W) x 35mm (D)	
Weight	:	470g [490g] including power pack, IC-BP3 and flexible antenna	

TRANSMITTER

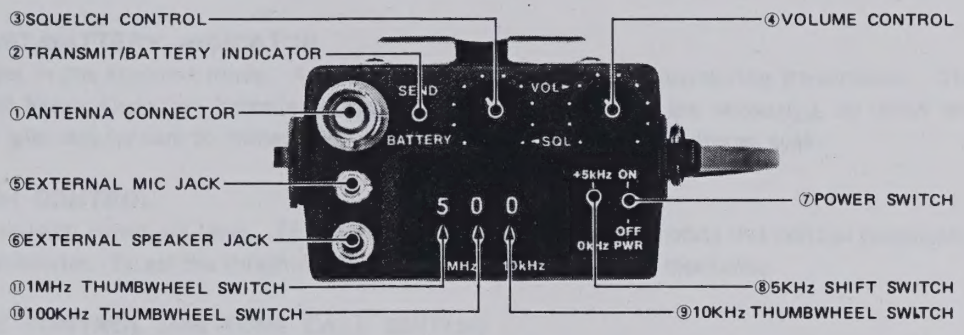
Output Power	:	HIGH: 1.5W, LOW: 0.15W at 8.4V
Emission Mode	:	16F$_3$
Modulation System	:	Variable reactance frequency modulation
Max. Frequency Deviation	:	±5KHz
Spurious Emission	:	More than 60dB below carrier
Microphone	:	Built-in electret condenser microphone Optional speaker-microphone (IC-HM9) can be used
Operating Mode	:	Simplex Duplex ±600KHz from receive frequency

RECEIVER

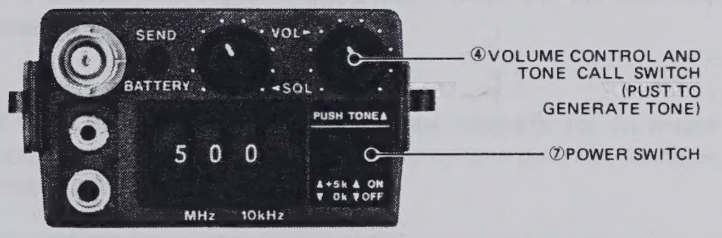
Receiving System	:	Double-conversion superheterodyne
Modulation Acceptance	:	16F$_3$
Intermediate Frequency	:	1st: 10.695MHz 2nd: 455KHz
Sensitivity	:	More than 26dB S+N+D/N+D at 1μV Less than 0.5μV for 20dB noise quieting
Squelch Sensitivity	:	Less than 0.4μV
Spurious response rejection ratio	:	More than 60dB
Selectivity	:	More than ±7.5KHz at −6dB point Less than ±15KHz at −60dB point
Audio Output Power	:	More than 300mW
Audio Output Impedance	:	8 ohms

Note: [ ] Values for IC-2AT, ( ) Values for IC-2Au and IC-2Ao, < > Values for IC-2E$_{DL}$ and IC-2E$_I$.
Specifications are approximate and are subject to change without notice or obligation.

TOP PANEL



IC-2A/2AT



IC-2E

FRONT PANEL

REAR PANEL

IC-2A, IC-2E IC-2AT

① **ANTENNA CONNECTOR**
Connect the supplied flexible antenna. An external antenna can be used, using a BNC connector.

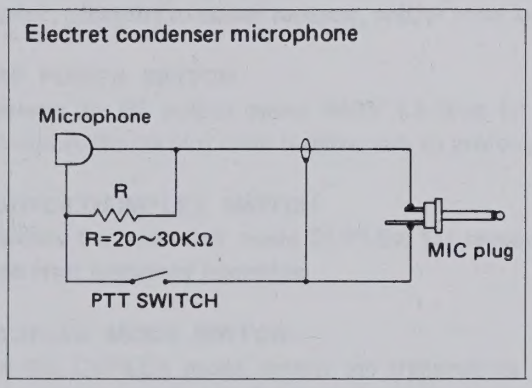
② **TRANSMIT/BATTERY INDICATOR**
Illuminates in the transmit mode. Also indicates the battery condition; during transmission. The voltage of Nickel-Cadmium batteries drops rapidly just before they are exhausted, so when this indicator goes out, be sure to immediately stop using it, and charge the batteries again.

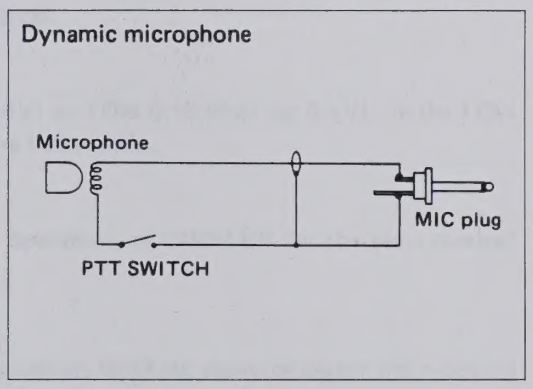
③ **SQUELCH CONTROL**
Sets the squelch threshold level. To turn OFF the squelch function, rotate this control completely counterclockwise. To set the threshold level higher, rotate the control clockwise.

④ **VOLUME CONTROL (and TONE CALL SWITCH)**
Controls the audio output level in the receive mode. Clockwise rotation increases audio output.

TONE CALL SWITCH (IC-2E only)
Most repeaters require a 1750Hz Tone-burst for initial access. Depressing the VOLUME CONTROL knob for the required period for a repeater, puts the set in the transmit mode and the tone-burst generator actuates and you can access the repeater.

⑤ **EXTERNAL MIC JACK**
When an external microphone is used, connect it to this jack. See the schematic for the proper hookup. When the external microphone is connected the built-in microphone does not function. The IC-HM9 optional speaker-microphone can also be used.





⑥ **EXTERNAL SPEAKER JACK**
When an external speaker (or an earphone) is used, connect it to this jack. Use a speaker with an impedance of 8 ohms. When the external speaker is connected the built-in speaker does not function.

⑦ **POWER SWITCH**
The ON/OFF switch controls the supplied power to the set.

⑧ **5KHz SHIFT SWITCH**
When the desired operating frequency has a 5KHz digit, set this switch in the +5KHz position, and add 5KHz to the indicated frequency on the thumbwheel switches.

⑨ **10KHz THUMBWHEEL SWITCH**
Sets 10KHz digit of the desired operating frequency.

⑩ **100KHz THUMBWHEEL SWITCH**
Sets 100KHz digit of the desired operating frequency.

⑪ **1MHz THUMBWHEEL SWITCH**

Sets 1MHz digit of the desired operating frequency. When you set a digit of a frequency that is out of the band, the set will work as follows:

Digit	Actual working frequency band	
	IC-2Au, IC-2Ao, IC-2AT, IC-2E$_{I}$	IC-2E$_{DL}$
0	144MHz	144MHz
1	145	145
2	146	144
3	147	145
4	144	144
5	145	145
6	146	144
7	147	145
8	144	144
9	145	145

⑫ **PUSH TO TALK (PTT) SWITCH**

For transmission, press this switch and talk into the microphone with normal voice. The internal microphone is of the electlet-condenser type and provides good pickup for all voice levels.

***TWO-TONE ENCODER PAD**

IC-2AT has a standard two-tone encoder pad on the front panel. The pad can be used for auto-patch, accessing to closed repeater, and/or other controls.

⑬ **RF POWER SWITCH**

Selects the RF output power HIGH 1.5 Watt (at 8.4V) or LOW 0.15 Watt (at 8.4V). In the LOW position, the current drain is decreased, to prolong the battery life.

⑭ **DUPLEX/SIMPLEX SWITCH**

Selects the operation mode DUPLEX for repeater operation, or SIMPLEX for the same receive/transmit frequency operation.

⑮ **DUPLEX MODE SWITCH**

In the DUPLEX mode, selects the transmitting frequency, 600KHz above or below the receiving frequency according to the desired repeater input frequency.

⑯ **CHARGER CONNECTOR**

Connects to the output plug of the wall charger BC-25U/E or other power source.

⑰ **BATTERY CHARGE INDICATOR**

Lights during battery charging.

SECTION 3 CIRCUIT DESCRIPTION

3-1 RECEIVER CIRCUITS

3-1-1 ANTENNA SWITCHING CIRCUIT

Signals from the antenna connector are fed to the antenna switching circuit through Chebyshev low-pass filter consisting of L29, L30, C95, C97 and C98 in the PLL board.

The antenna switching circuit employs a quater wave switching circuit.

In the receive mode, switching diodes, D16 and D17 are turned OFF, and they make isolation against the transmitter circuit and matching circuit, and the incoming signals are fed to the RF amplifier.

3-1-2 RF AMPLIFIER AND FIRST MIXER

The signals from the switching circuit are fed to the cascode amplifier Q1 and Q2.
The amplified signals are fed to the gate of the first mixer Q3 through the band-pass filter L2 ~ L4, which reduces interference and intermodulation from out of the band signals.

To the source of Q3, a 133MHz signal is supplied from the PLL circuit to convert the RF signals into 10.695MHz first IF signals.

The first IF signals are taken from the drain of Q3 and fed to the IF circuit.

3-1-3 IF CIRCUIT

The first IF signals from Q3 are fed to the matched pair crystal filter FI1, then IF amplifiers Q4 and Q5.

The amplified signals are fed to IC1. IC1 is composed of the second local oscillator, second mixer, limiter amplifier, quadrature detector and active filter circuits.

The second local oscillator oscillates 10.240MHz with X1, and is fed to the second mixer with the first IF signals to convert into 455KHz second IF signals. The second IF signals are put out from Pin 3, and fed to external ceramic filter FI2 which has excellent selectivity, then fed to IC1 (Pin 5) again to amplify and detect.
The detected AF signals are put out from Pin 9.

3-1-4 AF AND SQUELCH CIRCUITS

The detected AF signals are put 6dB/Octave de-emphasis by integral circuit consisting of R17 and C26, and fed to AF power amplifier IC2 through the VOLUME control R1, to obtain enough power to drive the speaker.

Noise components put out from Pin 9 of IC1 are fed to IC1 (Pin 10) again through the SQUELCH control R2, which controls the squelch threshold level, filtered about 20KHz signal (noise) and put out from Pin 11.

This signal (noise) is rectified by Q13, integrated by R35, R36 and C36, and turns Q14 ON and turns OFF the regulator for AF power amplifier consisting of D3, Q15 and Q16.

This reduces the current drain of the set, in the standby condition. When a signal is received, noise is suppressed by the signal and turns Q14 OFF and the regulator is turned ON and supplies regulated voltage to the AF power amplifier, and incoming signal can be heard from the speaker.
In the transmit mode, a voltage is applied to Q14 and turns it ON, and turns the regulator OFF the same as in the standby condition.

3-2 TRANSMITTER CIRCUITS

3-2-1 MIC AMPLIFIER CIRCUIT

Audio signals from the microphone are fed to the limiter amplifier, consisting of Q25 ~ Q28, which has 6dB/Octave response between 300Hz and 3KHz.

The output of the limiter amplifier is similar to rectangular waves and includes harmonics.
These harmonics are eliminated by the low-pass filter Q29, which cuts 3KHz or higher.
Filtered signals are fed to the VCO in the PLL board to make modulation.

3-2-2 MULTIPLIER AND DRIVER CIRCUITS

The VCO oscillates a half of a transmitting frequency, thus the multiplier Q8 and Q9, multiplies it two times to obtain 144MHz transmitting frequency.

This 144MHz is fed to amplifiers Q11 and Q12 through band-pass filter L19, L20 and L21, L22 to obtain 200 milliwatts pure 144MHz signal. While switching from receive to transmit, Q10 is turned ON by the charged voltage of C69, until the charged voltage has been discharged, and this function cuts the bias voltage of Q11 ~ Q13.

This prevents transmission of unwanted signals.

3-2-3 POWER AMPLIFIER CIRCUIT

The output signals from Q12 is fed to the power amplifier Q13, and amplified to 1.5 watts.
In the transmit mode, D16 and D17 are turned ON, and D17 makes L28 have high-impedance and D16 feeds the signals to the antenna through the low-pass filter.

3-3 PLL CIRCUITS

3-3-1 LOCAL OSCILLATOR CIRCUIT

The crystal oscillator Q6 oscillates 32.32625MHz with X2 for receive, 35.000MHz with X3 for simplex transmit, 35.150MHz with X4 for +600KHz and 34.850MHz with X5 for –600KHz duplex transmit, and the signal at two times this frequency is taken from the collector of Q7, and fed to the mixer of the PLL circuit.

In the receive mode, R+5V is applied to D10 through R23, L7, L11 and R27 and D10 is turned ON and selects X2.

In the simplex transmit mode, T+5V is applied to D11 through R24, L8, L12 and R28 and D11 is turned ON and selects X3.

In the +600KHz duplex transmit mode, T+5V is applied to D12 through R25, L9, L13 and R29 and D12 is turned ON and selects X4.

In the –600KHz duplex transmit mode, T+5V is applied to D13 through R26, L10, L14 and R30 and D13 is turned ON and selects X5.

When the operating frequency has a 5KHz digit, cathodes of D6 ~ D9 are grounded through the 5KHz SHIFT switch, and one of D6 ~ D9 is turned ON according to the operating mode. Thus, one of L7 ~ L10 is shunted accordingly and oscillating frequency is shifted 5KHz (on the operating frequency).

3-3-2 MIXER, LOW-PASS FILTER AND AMPLIFIER CIRCUITS

The output signals from the local oscillator circuit and the VCO signals fed through buffer amplifiers Q2 and Q3 are mixed by the mixer Q4. The output signals are fed to the low-pass filter to filter out only the signals below 5MHz, then fed to Q5 to be amplified to proper drive level (more than 3Vp-p) of the programmable divider IC1.

3-3-3 PROGRAMMABLE DIVIDER CIRCUIT

The input signals at Pin 2 of IC1 are divided by the BCD input signals from the thumbwheel switches at Pin 3 ~ 14.

The programmable divider is also called the 1/N counter and the BCD value is N.
The relationship between the operating frequency and the divide number N is:

N (divide number of programmable divider) = (Receive frequency (MHz) – 140) / 0.01

3-3-4 REFERENCE FREQUENCY GENERATOR CIRCUIT

Reference frequency generator IC3 consists of a crystal oscillator and a highspeed divider. X1 oscillates at 5.12MHz, which is divided by 1024. The 5KHz reference frequency is fed to phase detector IC2. This 5KHz reference frequency decides the variation step of the PLL output frequency.

3-3-5 PHASE DETECTOR AND LOOP FILTER CIRCUITS

Digital phase detector, IC2, detects the phase difference of the pulse signals of the 5KHz reference frequency and the output signal of the programmable divider, and proportionately puts out pulse signals at Pin 3, which becomes high impedance when the PLL is locked.

Pin 4 is for detecting the lock failures and changes to ground level according to the phase difference of the two pulse signals. When the lock fails, the pulse signal from Pin 4 is integrated by R2 and C15. When the integrated voltage exceeds the junction voltage of Q14's base, Q14 is turned ON and then Q7 in the MAIN board is turned ON.

The collector of Q7 is connected to the base of Q8, so the base voltage of Q8 becomes ground level, and Q8 and Q6 are shut off to prevent transmitting unwanted signals.

The loop filter, consisting of R4, R5, R6, C13 and C14, converts the pulse signal from Pin 3 into a DC voltage and decides the response time of the whole loop.

The output signals are fed to tuning diode D3 of the VCO circuit as the control voltage for the VCO frequency set.

3-3-6 VCO CIRCUIT

The VCO (Voltage-Controlled Oscillator) is a Colpitts circuit using Q1, and oscillates in 70MHz range.

The oscillator frequency is controlled by a DC voltage which is supplied from the loop filter to varactor diode D3.

In the receive mode, R+5V is applied to D4's anode through L1, and D4 is turned ON and shunts C20. Thus the free-run frequency of the VCO is lowered.

In the transmit mode, T+5V is applied to D4's cathode through D5 and L2, D4 is turned OFF, and C20 is inserted in the oscillator circuit in series. Thus the free-run frequency of the VCO is increased. In the same time, the VCO signal is frequency modulated by the audio signals from the microphone which are applied to the gate of Q1 and varies Q1's mutual conductance.

3-4 OTHER CIRCUITRY

3-4-1 POWER SUPPLY CIRCUIT

The regulated 5V is supplied to the main circuits, so that the set operates under a stable condition with as low a power voltage as possible.

The power supply voltage is fed to the AF power amplifier through the squelch switching circuit and to the 5V regulator consisting of Q17 ~ Q20 and zener diode D4. This regulated 5V is supplied to the PLL circuit.

In the transmit mode, the base of Q23 is grounded through R55, the microphone and the PTT switch, and Q23 is turned ON. Thus Q6 and Q8 are turned ON and T+5V is actuated, and supplied to the transmitter circuit. At the same time, T+5V turns Q12 ON, and the power supply voltage is applied to the MIC amplifier circuit through Q12.

In the receive mode, Q23 is turned OFF and the bias voltage of Q9 ON. Thus the R+5V is actuated and supplied to the PLL board to switch the local oscillator crystal and the driver transistors of the transmitter circuit.

At the same time, R+5V turns ON the voltage boost circuit consisting of Q10 and Q11, and +6V is supplied to the receiver circuit.

LED INDICATOR CIRCUIT

This LED is lit in the transmit mode, but when the power supply voltage becomes less than 5.5V, it will not be lit.

The power supply voltage is divided by R48 and R49, and applied to the base of Q21. The emitter of Q21 is connected to the regulated 5V source. When the power supply voltage is more than 5.5V, Q21 is turned OFF, Q22 is turned ON and T+5V is applied to the LED through Q22 and R50, and LED is lit.

3-4-2 TWO-TONE ENCODER CIRCUIT (IC-2AT only)

IC1 is a standard 12 key two-tone encoder which is compatible with any telephone system. When a key is pushed, IC1 oscillates 3.5795MHz with X1, and its signal is divided depending on the pushed key, and a pair of tones is put out from Pin 16. At this time, Pin 10 of IC1 puts out H-level signal, and this is used to mute the mic amplifier.

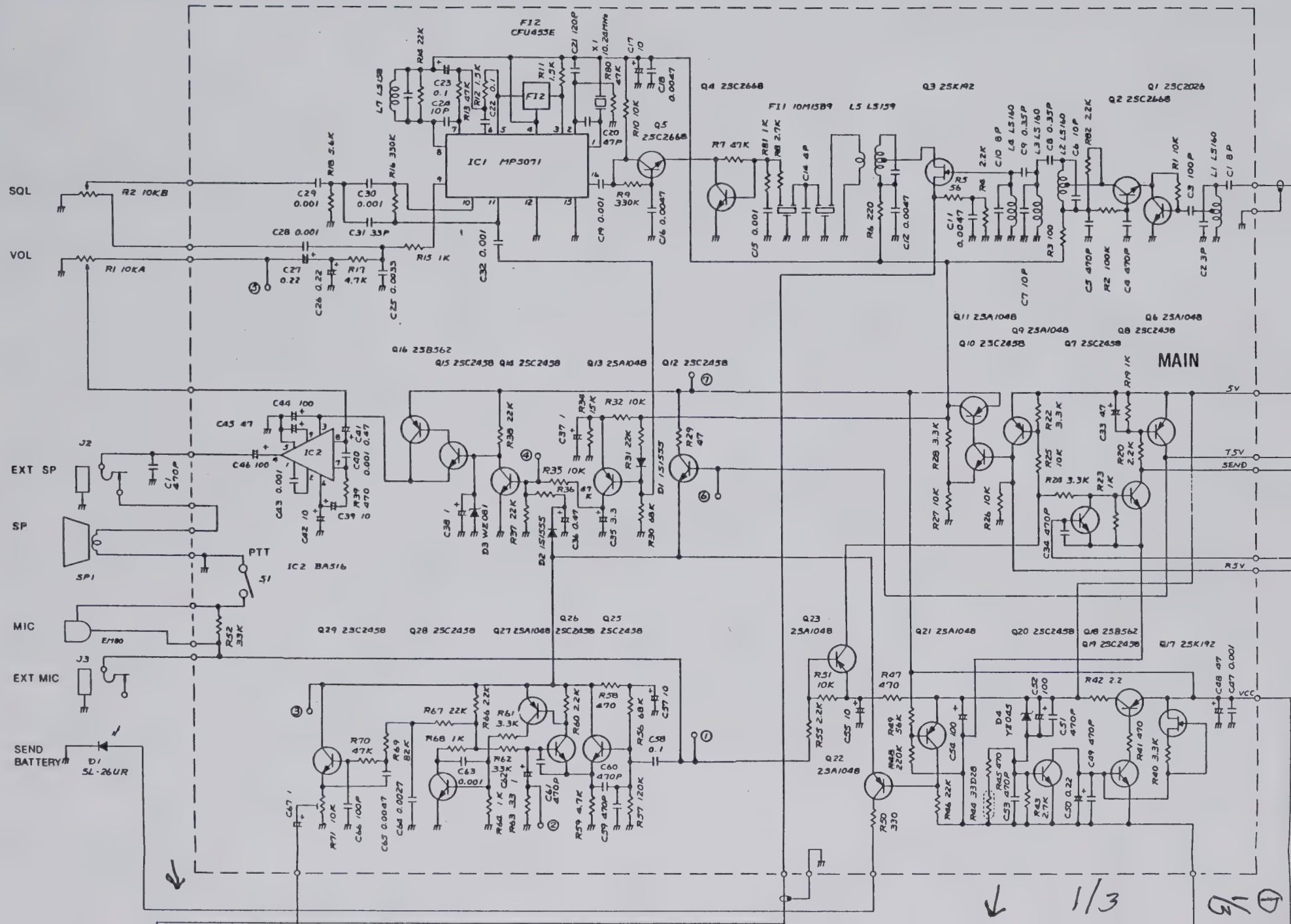
3-4-3 TONE-BURST GENERATOR CIRCUIT (IC-2E only)

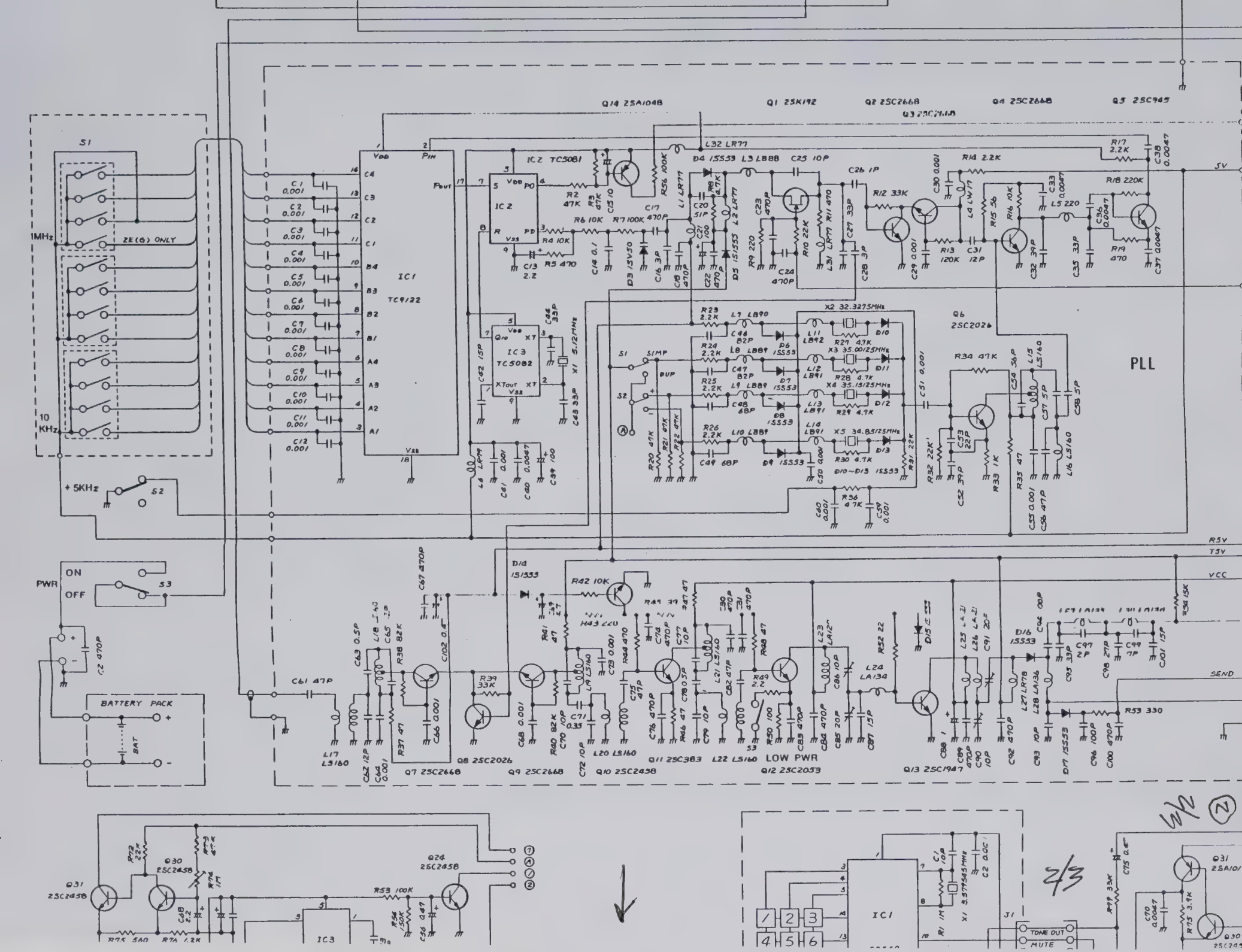
When the TONE CALL switch is depressed, Q23's base is grounded through R55 and D6, and the set is turned in the transmit mode. At the same time, Q33's base is also grounded through R83, and Q33 is turned ON and supplies a voltage to IC3.

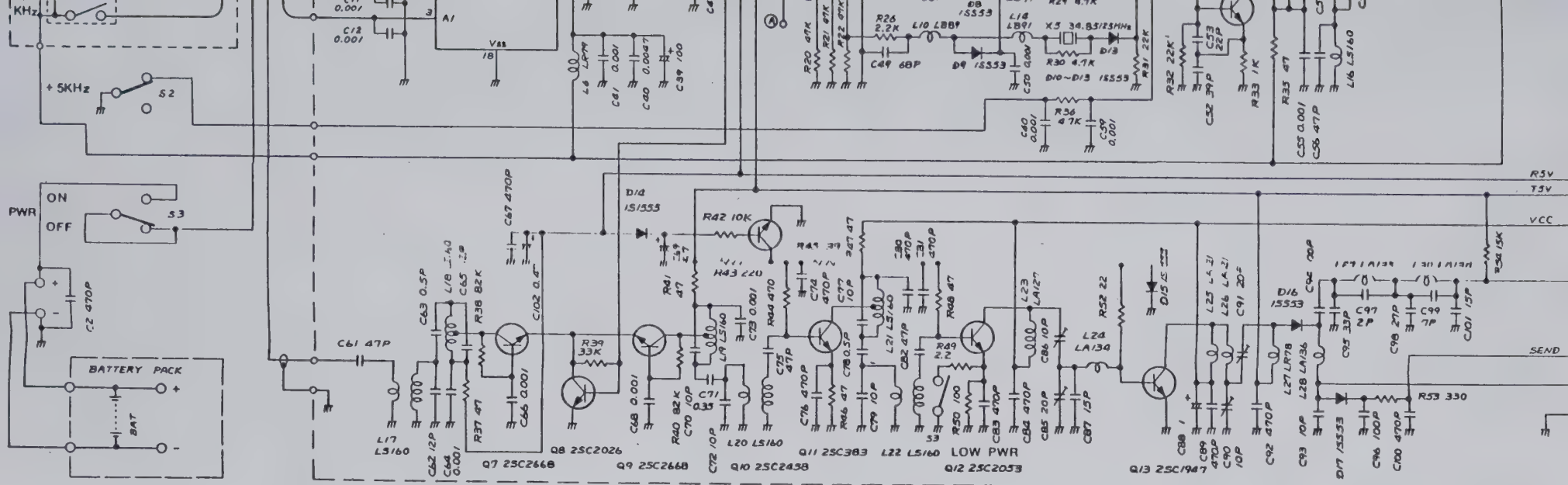
IC3 consists of a crystal oscillator and dividers. X2 oscillates at 7.168MHz, which is divided by 4096.

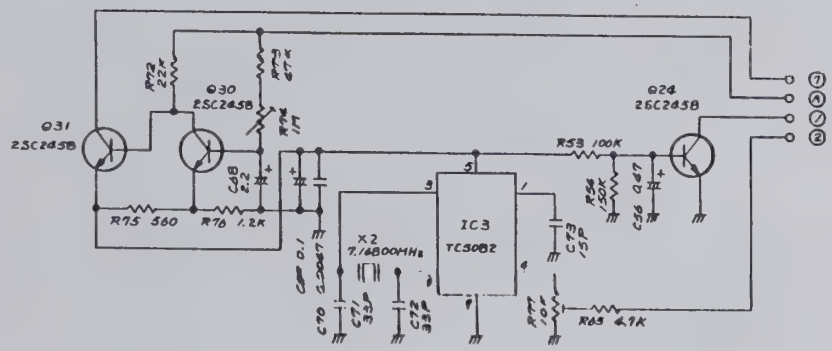
The 1750Hz tone is put out from Pin 4 of IC3 and fed to the mic amplifier circuit through R77, level adjust trimmer.

IC-2A/AT/E SCHEMATIC DIAGRAM

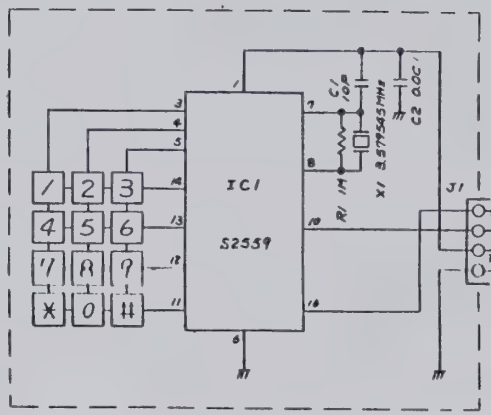



PLL
IC1 TC9122
IC2 TC5081
IC3 TC5082
S1
S2
S3
ON
OFF
PWR
BATTERY PACK
+5KHz
MHz
10 KHz
ZE(G) ONLY
Q1 2SK192
Q2 2SC2668
Q3 2SC2668
Q4 2SC2668
Q5 2SC945
Q6 2SC2026
Q7 2SC2668
Q8 2SC2026
Q9 2SC2668
Q10 2SC2458
Q11 2SC383
Q12 2SC2053
Q13 2SC1947
Q14 2SA1048
LOW PWR
SEND
5V
R5V
T5V
VCC

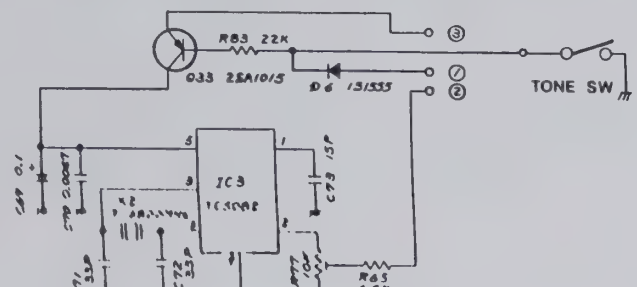




IC-2E AUTO TONE



IC-2AT ONLY



IC-2E INDEPENDENT TONE

ICOM ICOM INCORPORATED

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3/3

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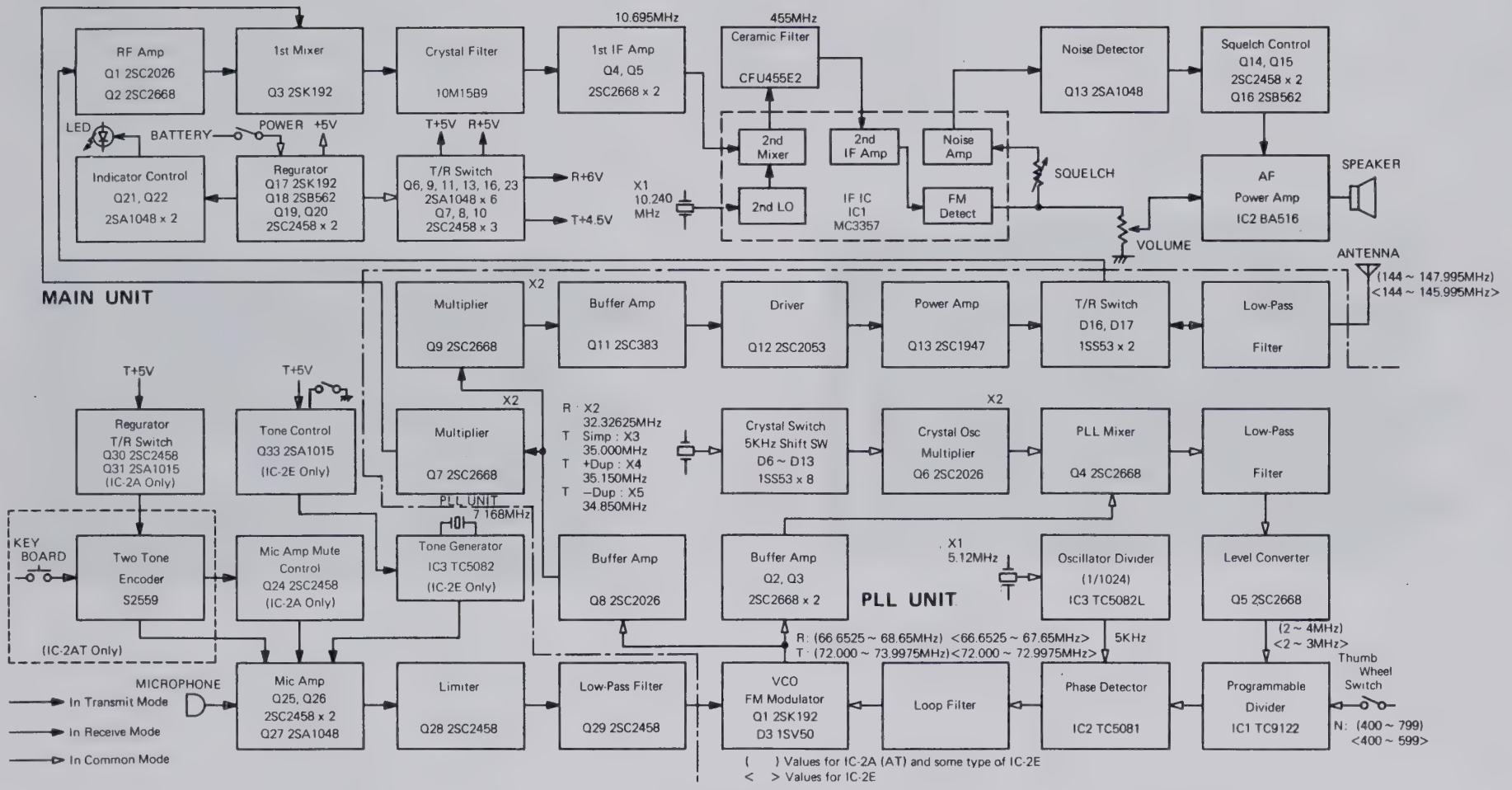
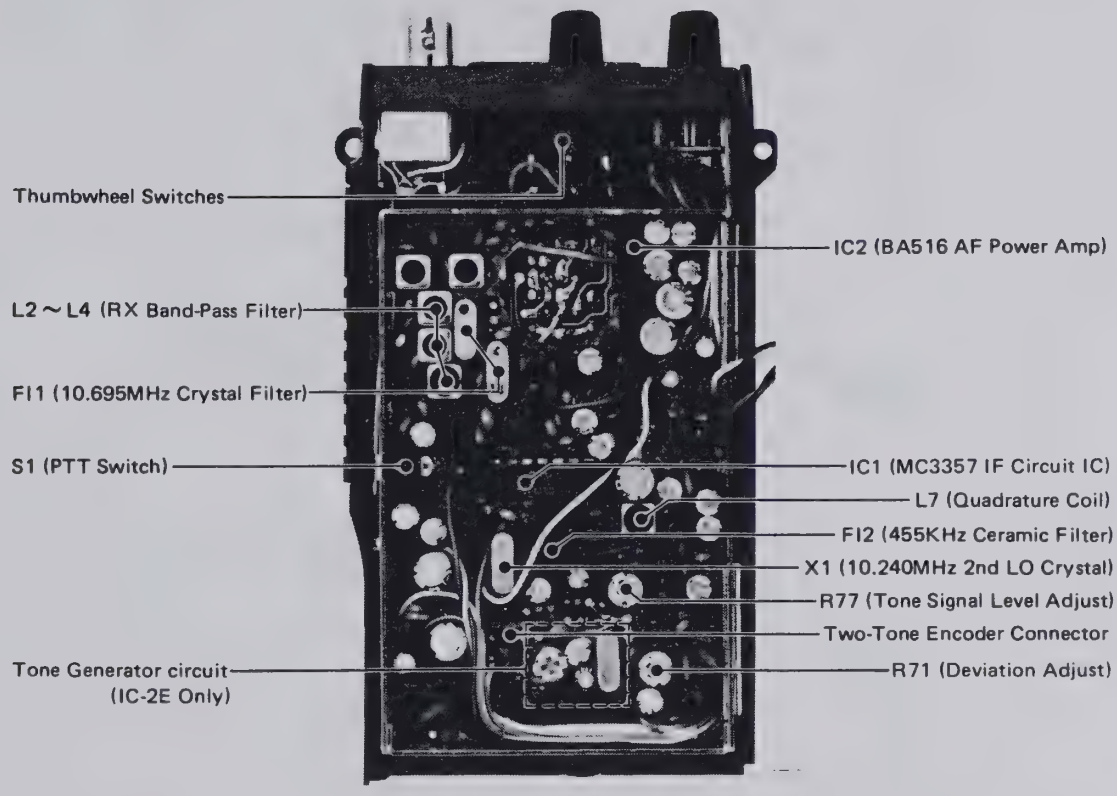
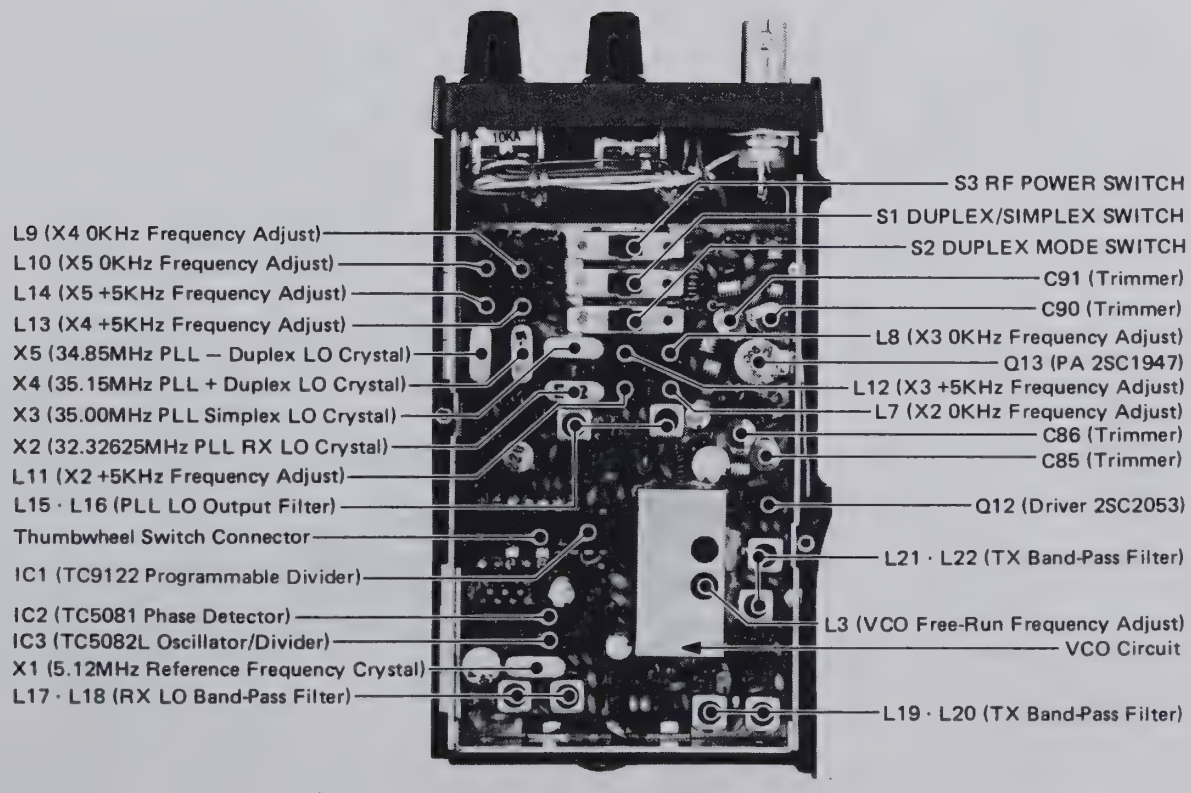

MAIN UNIT
RF Amp
Q1 2SC2026
Q2 2SC2668
1st Mixer
Q3 2SK192
Crystal Filter
10M15B9
10.695MHz
1st IF Amp
Q4, Q5
2SC2668 x 2
455MHz
Ceramic Filter
CFU455E2
Noise Detector
Q13 2SA1048
Squelch Control
Q14, Q15
2SC2458 x 2
Q16 2SB562
LED
BATTERY
POWER +5V
Indicator Control
Q21, Q22
2SA1048 x 2
Regurator
Q17 2SK192
Q18 2SB562
Q19, Q20
2SC2458 x 2
T+5V R+5V
T/R Switch
Q6, 9, 11, 13, 16, 23
2SA1048 x 6
Q7, 8, 10
2SC2458 x 3
R+6V
T+4.5V
X1
10.240
MHz
2nd
Mixer
2nd LO
2nd
IF Amp
IF IC
IC1
MC3357
Noise
Amp
FM
Detect
SQUELCH
VOLUME
AF
Power Amp
IC2 BA516
SPEAKER
ANTENNA
(144 ~ 147.995MHz)
<144 ~ 145.995MHz>
Multiplier
Q9 2SC2668
X2
Buffer Amp
Q11 2SC383
Driver
Q12 2SC2053
Power Amp
Q13 2SC1947
T/R Switch
D16, D17
1SS53 x 2
Low-Pass
Filter
T+5V
T+5V
Regurator
T/R Switch
Q30 2SC2458
Q31 2SA1015
(IC-2A Only)
Tone Control
Q33 2SA1015
(IC-2E Only)
Multiplier
Q7 2SC2668
X2
R : X2
32.32625MHz
T Simp : X3
35.000MHz
T +Dup : X4
35.150MHz
T –Dup : X5
34.850MHz
Crystal Switch
5KHz Shift SW
D6 ~ D13
1SS53 x 8
Crystal Osc
Multiplier
Q6 2SC2026
X2
PLL Mixer
Q4 2SC2668
Low-Pass
Filter
PLL UNIT
7.168MHz
KEY
BOARD
Two Tone
Encoder
S2559
(IC-2AT Only)
Mic Amp Mute
Control
Q24 2SC2458
(IC-2A Only)
Tone Generator
IC3 TC5082
(IC-2E Only)
Buffer Amp
Q8 2SC2026
Buffer Amp
Q2, Q3
2SC2668 x 2
X1
5.12MHz
Oscillator Divider
(1/1024)
IC3 TC5082L
Level Converter
Q5 2SC2668
PLL UNIT
R: (66.6525 ~ 68.65MHz) <66.6525 ~ 67.65MHz>
T: (72.000 ~ 73.9975MHz) <72.000 ~ 72.9975MHz>
5KHz
(2 ~ 4MHz)
<2 ~ 3MHz>
MICROPHONE
In Transmit Mode
In Receive Mode
In Common Mode
Mic Amp
Q25, Q26
2SC2458 x 2
Q27 2SA1048
Limiter
Q28 2SC2458
Low-Pass Filter
Q29 2SC2458
VCO
FM Modulator
Q1 2SK192
D3 1SV50
Loop Filter
Phase Detector
IC2 TC5081
Programmable
Divider
IC1 TC9122
Thumb
Wheel
Switch
N: (400 ~ 799)
<400 ~ 599>
( ) Values for IC-2A (AT) and some type of IC-2E
< > Values for IC-2E

SECTION 5 INSIDE VIEWS

MAIN UNIT SIDE

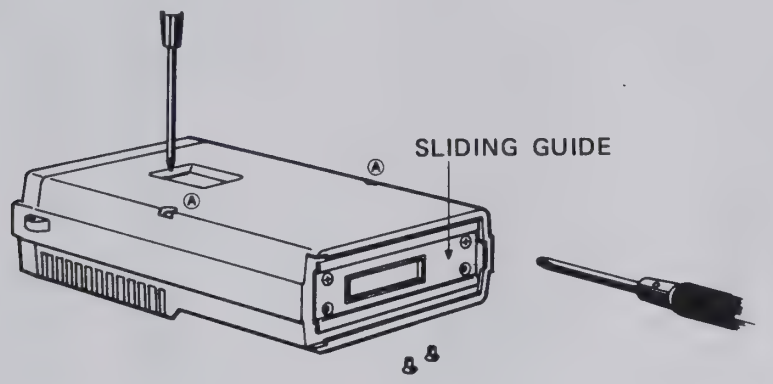


PLL UNIT SIDE

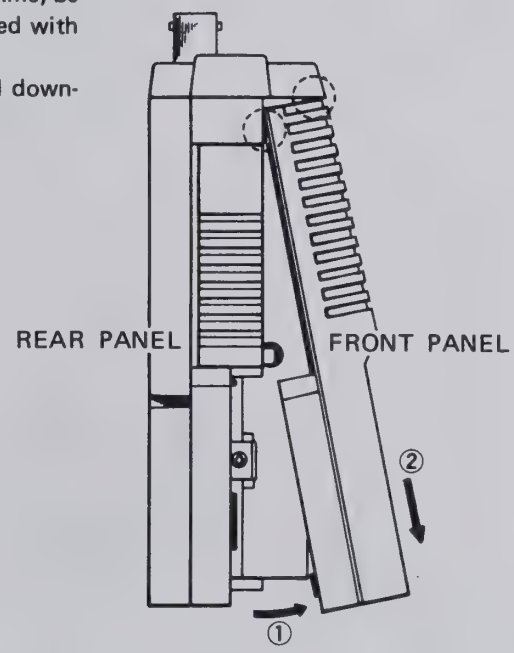


6 - 1 DISASSEMBLY OF THE CASES

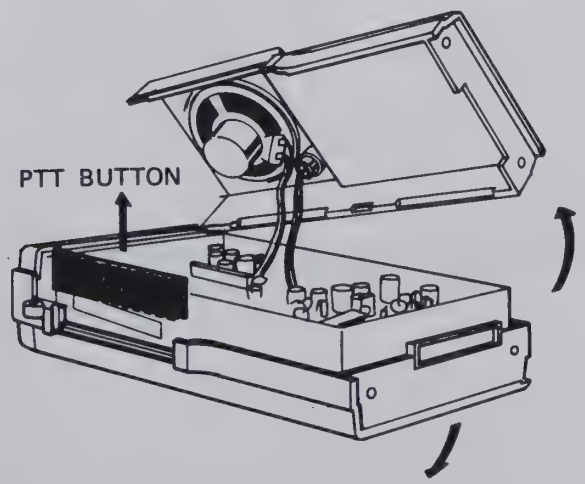
1. Turn the power switch off and remove the power pack.
2. Remove two screws Ⓐ on the rear panel and four screws on the bottom as shown in the figure.



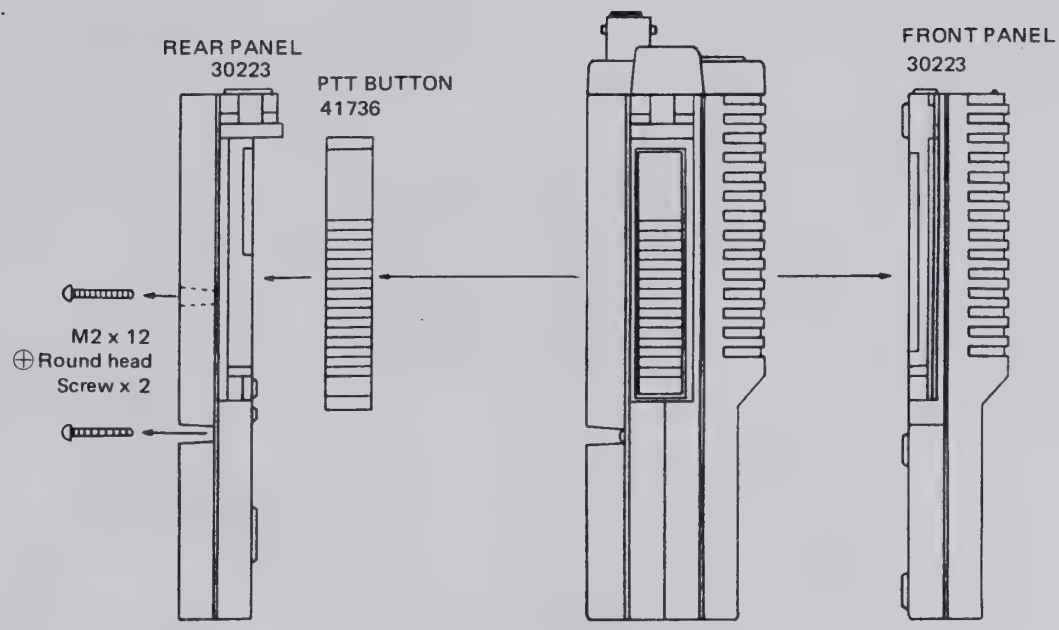
3. Remove the front panel as shown in the figure. At this time, be sure not to damage the engaged parts at the top (circled with dotted lines).
   ① open the bottom slightly and ② slide the front panel downwards.



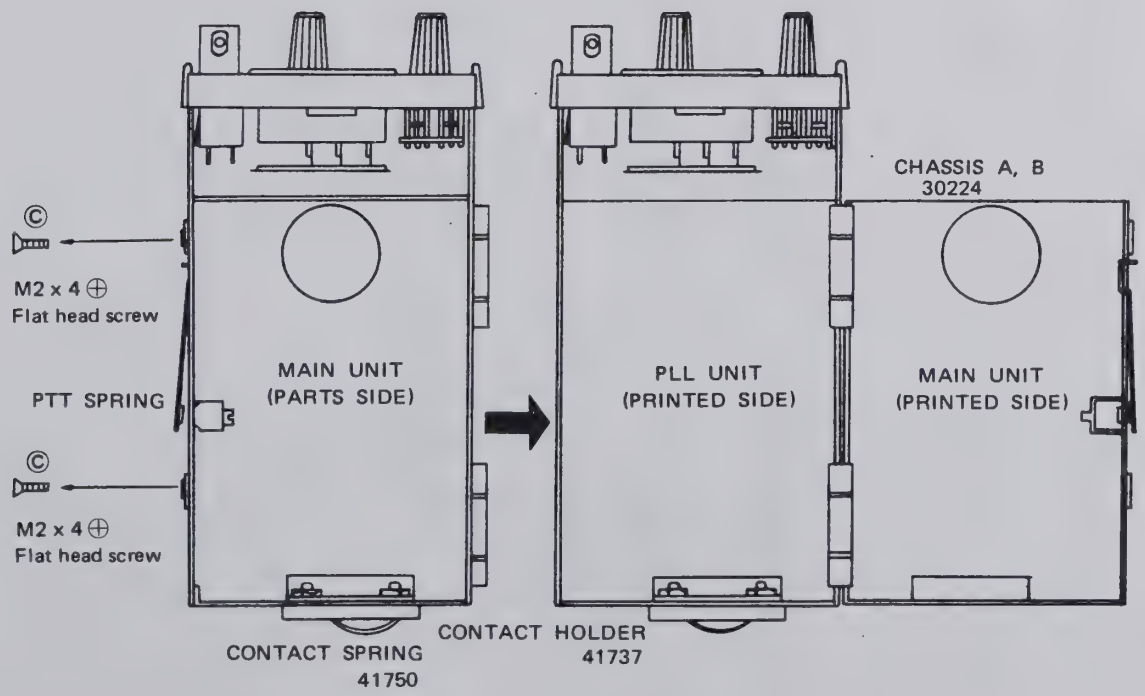
4. Slide the PTT Button upward, and then remove the rear panel.



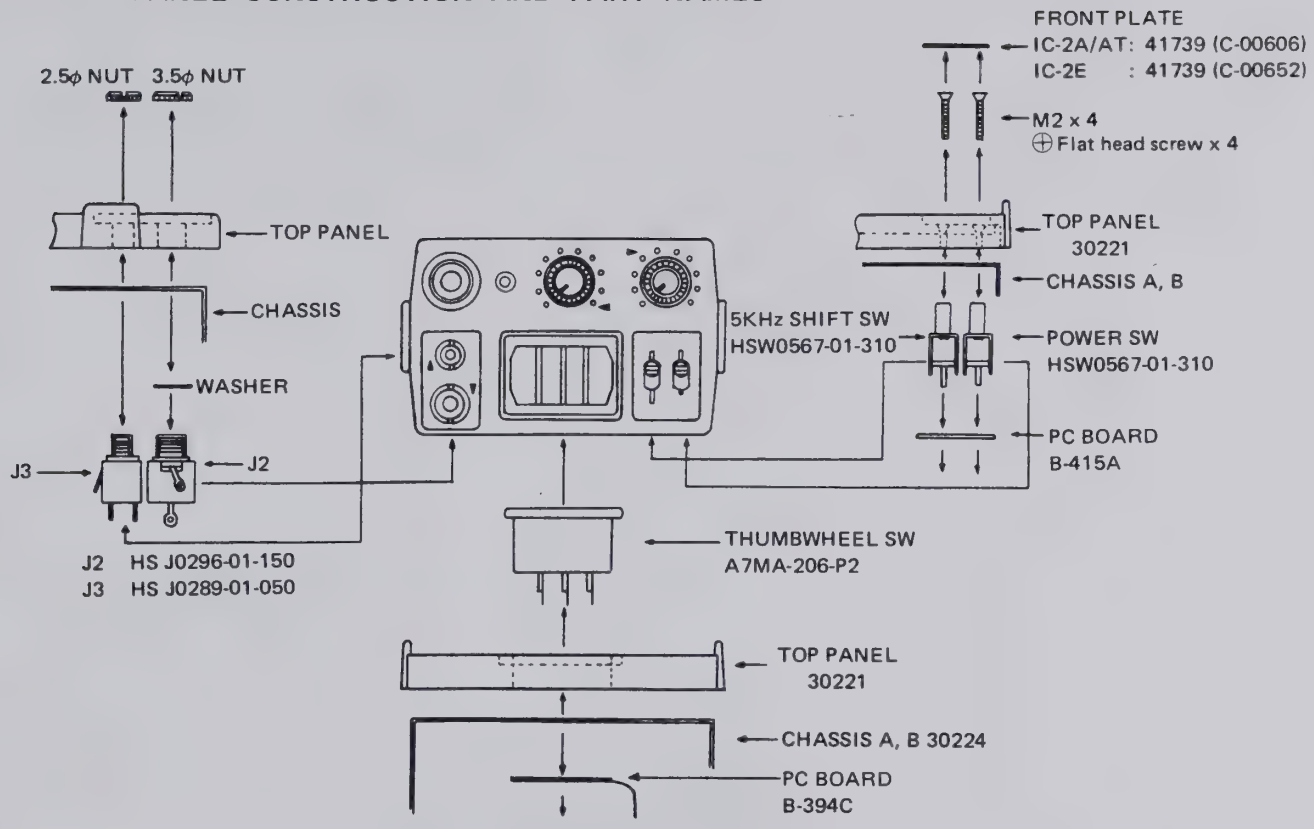
6 - 2 DISASSEMBLY OF UNITS



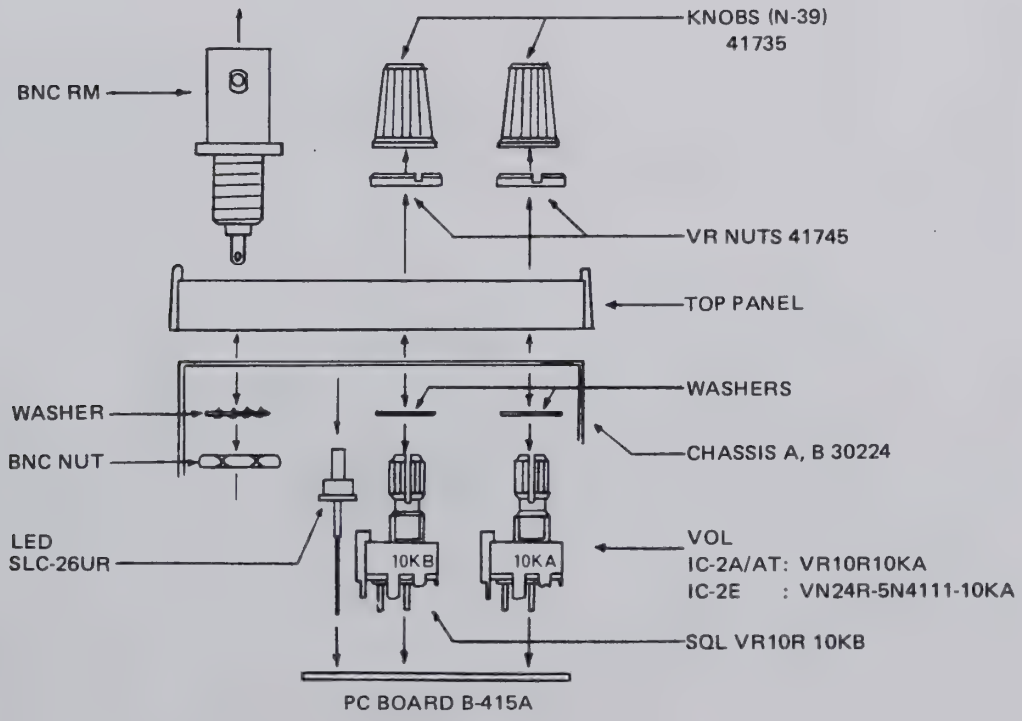
To see the printed sides of the PC boards, open the chassis by removing two screws Ⓒ located above and below the PTT spring.



6 - 3 TOP PANEL CONSTRUCTION AND PART NAMES

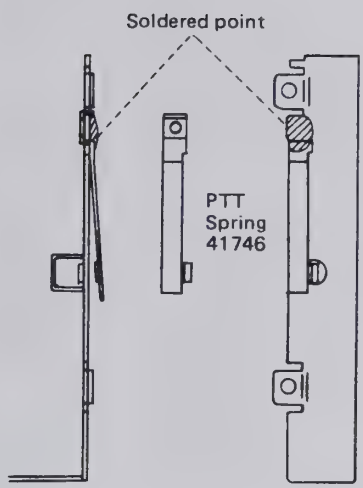


6 - 4 VOL/SQL CONTROLS AND BNC CONNECTOR ASSEMBLY

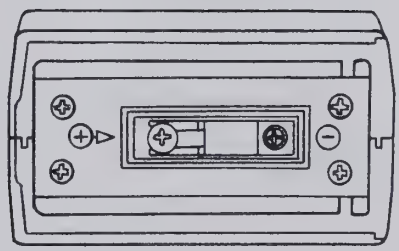


6 - 5 PTT SPRING ASSEMBLY (HOW TO REPLACE PTT SPRING)

1. The PTT spring is soldered at its top as shown in the figure.
2. Remove the old spring by heating the soldered point.
3. Solder the hole at the top of the new spring.
4. Make sure that the new spring is soldered on parallel to the chassis.

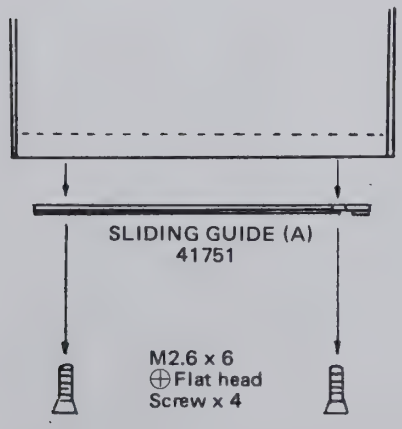


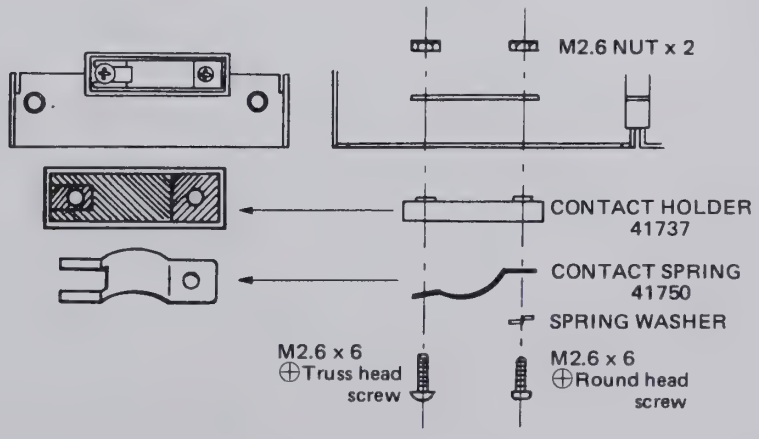
6 - 6 UNIT BOTTOM ASSEMBLY (BOTTOM VIEW)



(HOW TO REPLACE CONTACT SPRING)

1. Remove the sliding guide by removing the four screws as shown.
2. Remove the contact spring by removing the two screws as shown.
3. Set the new contact spring so that the split and of the spring is on the positive side and the other end on the negative side.
4. Tighten the two screws.





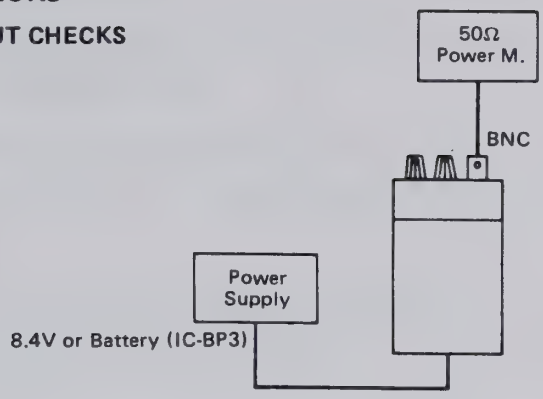
SECTION 7 MAINTENANCE AND ADJUSTMENT

7 - 1 MEASURING INSTRUMENTS REQUIRED FOR ADJUSTMENT

(1) FREQUENCY COUNTER	FREQUENCY RANGE	0.1 - 160MHz
	ACCURACY	BETTER THAN ±1 ppm
	SENSITIVITY	100mV or BETTER
(2) SIGNAL GENERATOR	FREQUENCY RANGE	0.1MHz - 160MHz
	OUTPUT VOLTAGE	−20 - 90dB (0dB = 1μV)
(3) MULTIMETER	50KΩ/Volt or better	
(4) AC MILLIVOLTMETER	MEASURING RANGE	10mV - 2V
(5) RF VOLTMETER	FREQUENCY RANGE	0.1 - 160MHz
	MEASURING RANGE	0.01 - 10V
(6) RF WATTMETER (Terminated Type)	MEASURING RANGE	5 Watts
	FREQUENCY RANGE	140 - 160MHz
	IMPEDANCE	50 OHMS
	SWR	LESS THAN 1.1
(7) AF OSCILLATOR	OUTPUT FREQUENCY	200 - 3000Hz
	OUTPUT VOLTAGE	0 - 100mV
	DISTORTION	LESS THAN 0.1%
(8) OSCILLOSCOPE	FREQUENCY RANGE	DC – 10MHz
	MEASURING RANGE	0.01 – 10V
(9) FM DEVIATION METER	FREQUENCY RANGE	140 ~ 160MHz
	MEASURING RANGE	0 ~ ±10KHz
(10) DIRECTIONAL COUPLER	FREQUENCY RANGE	140 ~ 160MHz
(11) AMPERMETER	MEASURING RANGE	0 ~ 1A DC
(12) DUMMY LOAD OR EXTERNAL SPEAKER	IMPEDANCE	8 OHMS
(13) VOLTAGE REGULATED POWER SUPPLY	OUTPUT VOLTAGE	5 ~ 11V DC (Adjustable)
	CAPACITY	1A OR MORE

7-2 PRELIMINARY CHECKS

7-2-1 TRANSMITTER OUTPUT CHECKS



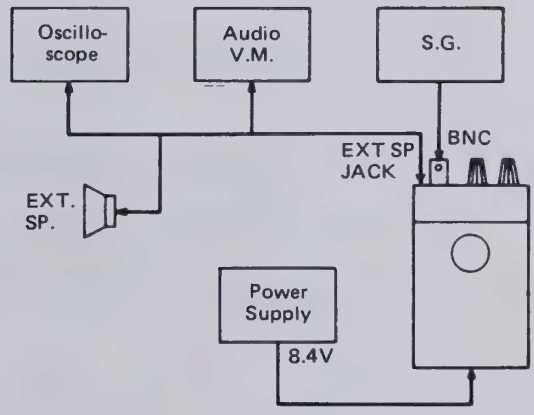
1. Connect a 50 ohm RF wattmeter to the ANT connector.
2. Setting the IC-2A frequency 147.000MHz (IC-2E : 145.000MHz) and key the transmitter. Observe the RF power OUTPUT.
3. Power output should be 1.5 watts at rated input voltage.

7-2-2 RECEIVER CHECKS

Make all checks at 8.4V DC

1. Settings of controls and switches

Power switch	ON
Squelch Control	Minimum position
Dup/Simp Switch	Simp
Frequency	147.000MHz (IC-2E : 145.000MHz)



2. Connect an AF voltmeter to the SP jack and set the SQL control fully counterclockwise.
3. Connect the RF output of a VHF signal generator to the ANT connector.
4. Adjust the VOL control and the AF voltmeter range.
   Adjust the VOL control for a full scale reading on the AF voltmeter. Don't change the VOL control setting after this adjustment.
5. Set the signal generator to the receiving frequency and adjust the output level of the signal generator until the AF voltmeter shows a 20dB decrease in reading.
6. The signal/generator output voltage at this point is the 20dB quieting sensitivity.

7-3 PREPARATION AND PROCEDURE BEFORE SERVICING

1. Confirm defective operation and check to make sure setup or external sources are not the cause of the problem.
2. Proper tools and measuring instruments are required for repair and adjustment. Don't try to repair or modify without them.

3. Remove the transceiver case as shown on Page 6 - 1. Use a screw driver that fits the screw.

4. IC-2AT has two-tone oscillator at the front panel with wires connecting it to the main board. If you force the cover removing it, a wire could be broken.

5. To open the hinge chassis remove the two screws as shown on Page 6 - 2.

6. Attach an 8.0 ~ 11.0V DC external power source to the battery clip or screw. Be sure to check the polarity.

7. In the case of a transmission problem, a dummy load should be connected to the antenna connector. In the case of a receiving problem, an antenna or signal generator is connected to the antenna connector. Be careful not to transmit into the signal generator.

8. Recheck for the suspected malfunction with the power switch on.

9. Check the defective circuit and measure the DC voltages of the collector, base and emitter of each transistor.

10. When checking a transmission problem, it is convenient to short circuit an accessory mic connector plug and insert it, turning on the transmitter.

7 - 4 HOW TO CHECK

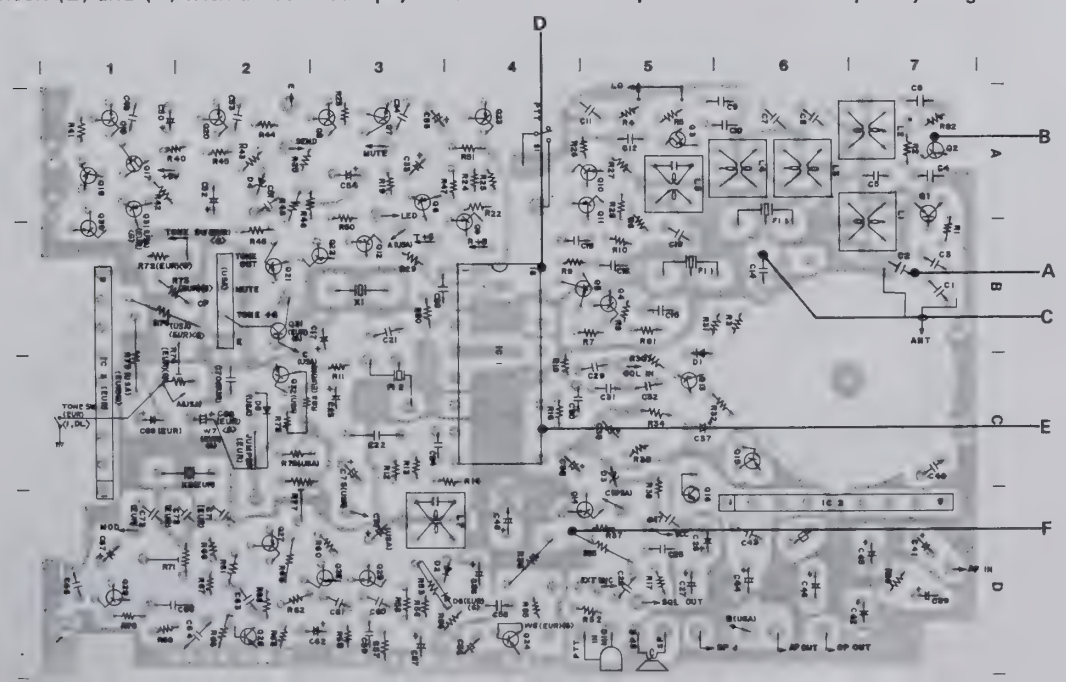
7 - 4 - 1 RECEIVE

1. Check the frequency of P.L.L. unit when you are unable to receive with a strong signal present and noise present when turning up the AF volume.

2. When no noise is present at the speaker, check audio frequency amplifier or 5V regulator first.

3. Inject RF through a 0.01μF capacitor from an FM signal generator modulated with 1KHz audio modulation (FM), to points (A) through (D) in order, check for receiver output.
   (A) = 146.000MHz (IC-2E : 145.000MHz)
   (B) = 146.000MHz (IC-2E : 145.000MHz)
   (C) = 10.695MHz
   (D) = 10.695MHz

4. Check (E) and (F) with an oscilloscope, for demodulated output in the audio frequency range.

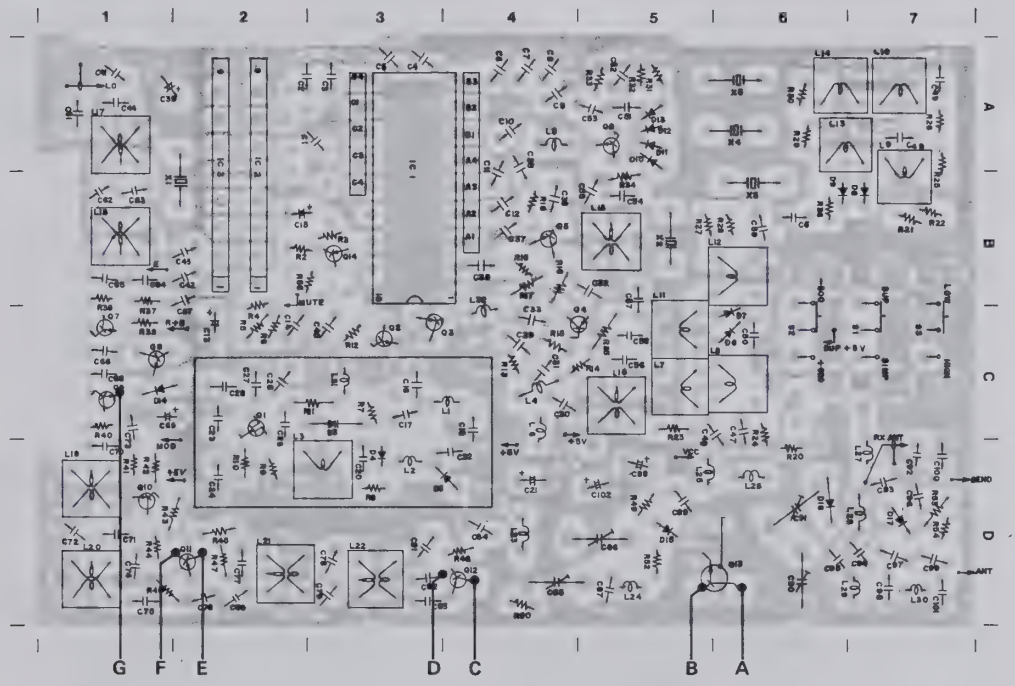


7 - 4 - 2 TRANSMITTER

1. Check (A) through (G) in order with RF voltmeter.

2. When the transmitter output is low, check regulated power supply voltage first, do not turn coil trimmers.

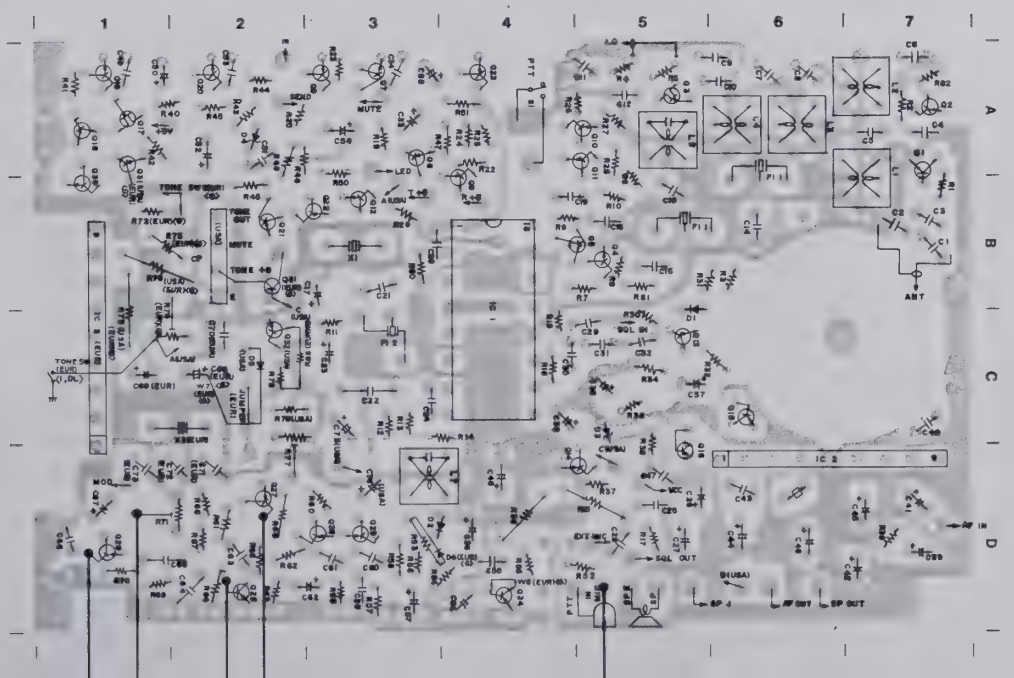
3. When transmission is normal, RF is present and it is not possible to measure the DC voltage accurately with a voltmeter.



7 - 4 - 3 MODULATION

1. Put a signal into the EXT MIC connector (1KHz 40mV) with an AF oscillator or an external mic.

2. Check the AF voltages (A) through (E) in order with an oscilloscope.



7-4-4 P.L.L.

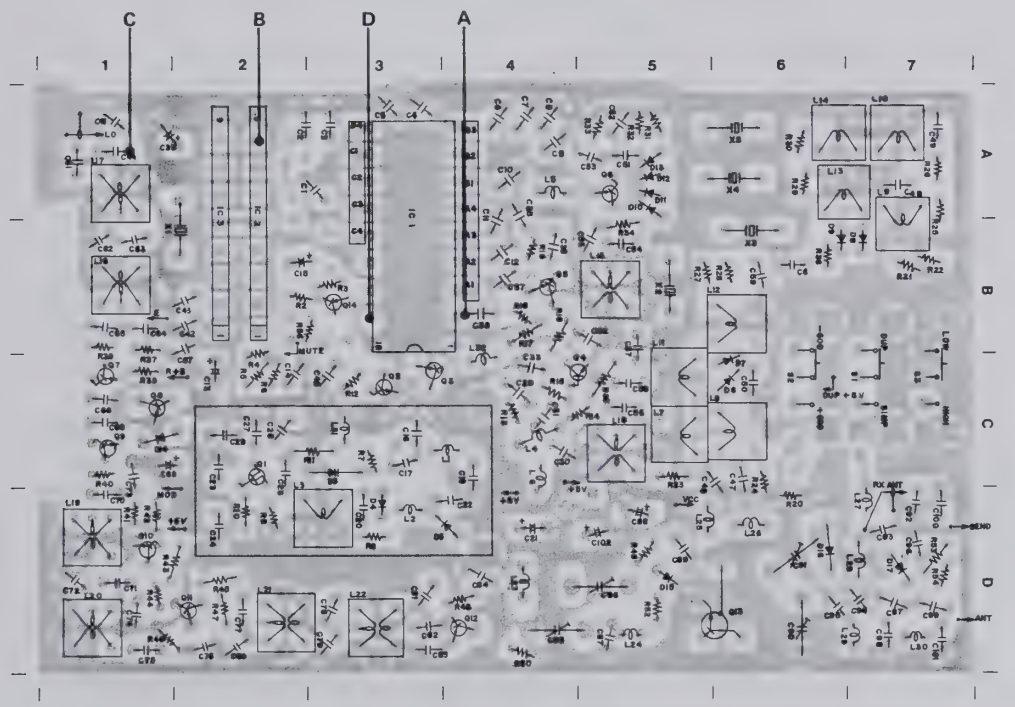
1. Check (A) with an oscilloscope. A lock failure is indicated by an instability or absence of the wave form. Check as follows:

2. Check the Frequency of the master oscillator (10.24MHz). If a 5KHz 5Vp-p squarewave is not observed at (B), measure DC voltage on Pin 5 of IC3 if no oscillation.

3. Wave measure the output of (C) and (D) with an oscilloscope.

4. Measure DC voltage of Q1, Q2, Q3, Q4 and Q5.

5. If the transmit or receive frequency differs from the display, check the voltage of A1 to C4 on the IC1 (BCD control lines from top switches).



BCD CHART

	10KHz				100KHz				1MHz			
INPUT BCD	1 A1	2 A2	4 A3	8 A4	1 B1	2 B2	4 B3	8 B4	1 C1	2 C2	4 C3	8 C4
FREQUENCY 144.00	L	L	L	L	L	L	L	L	L	L	H	L
144.01	H	L	L	L	L	L	L	L	L	L	H	L
144.02	L	H	L	L	L	L	L	L	L	L	H	L
144.03	H	H	L	L	L	L	L	L	L	L	H	L
⋮			⋮				⋮				⋮	
145.98	L	L	L	H	H	L	L	H	H	L	H	L
145.99	H	L	L	H	H	L	L	H	H	L	H	L
146.00	L	L	L	L	L	L	L	L	L	H	H	L
146.01	H	L	L	L	L	L	L	L	L	H	H	L
146.11	H	L	L	L	H	L	L	L	L	H	H	L
146.12	L	H	L	L	H	L	L	L	L	H	H	L
147.00	L	L	L	L	L	L	L	L	H	H	H	L
147.50	L	L	L	L	H	L	H	L	H	H	H	L
147.99	H	L	L	H	H	L	L	H	H	H	H	L

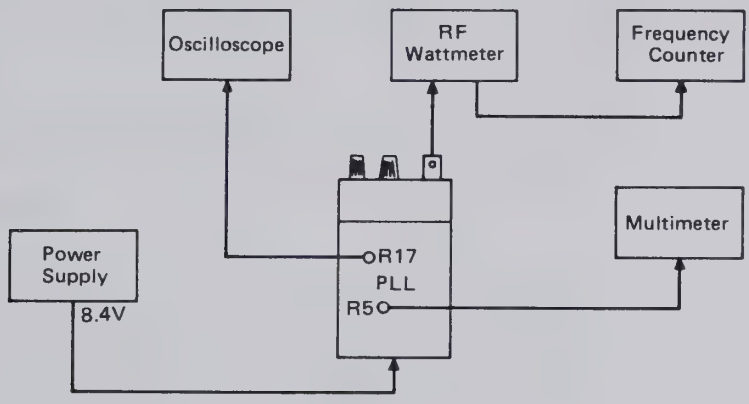
H = 5V L = 0V

7-5 BASIC ALIGNMENT PROCEDURE

7-5-1 P.L.L. CIRCUIT

A. Lock Adjustment

1. Connect the measuring instrument and set the control knobs as follows:
   - Connect an oscilloscope (10MHz band width) to R17.
   - Connect voltmeter between R5 and ground.
   - Set thumbwheel switches to 144.00MHz.



2. Procedure

   When the circuit is operating normally, adjust coil L3. The P.L.L. will lock.
   - Adjust the coil of L3, and the voltage of R5 varies between 0 ~ 5V, and P.L.L. should lock.
   - Adjust L3 for 1V after lock.

   Next, in Receive adjust L16 for maximum voltage (P-P value) on the oscilloscope and then during transmission adjust L15 to maximum. Repeat adjustment of L15, L16 several times. After that, confirm the following voltage of R5 (both transmission and receiving) 1V ±0.3V at 144MHz, and that the voltage of R17 (both transmission and receiving) is over 3Vp-p (over operating range of the radio). If the P.L.L. won't lock, check these voltages: R+5V, T+5V, 5V constant, and the P.L.L. LO and reference frequency oscillator for oscillation. Connect a counter to R37, and check the oscillation frequency of the V.C.O. during transmission.

   If unlocked check that L3 can be adjusted as follows:

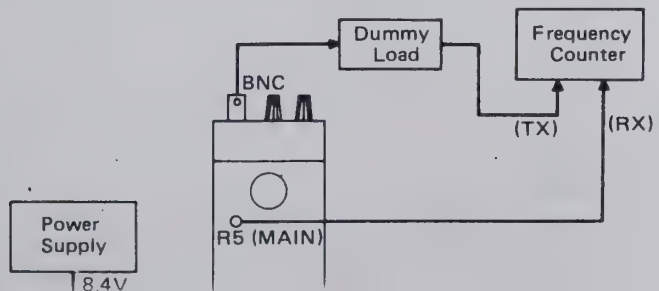
   - Adjust L3 to 65MHz when the voltage of R5 is 0V.
   - Adjust L3 to 70MHz when the voltage of R5 is 5V.

B. Reference Frequency Oscillator Check

1. Connect a counter through a capacitor to Pin 1 on IC3.
2. Confirm frequency is: 5.12MHz ±250Hz.

C. P.L.L. LO Frequency Adjustment

1. Connection of the measuring instruments and the setting of knob.
   - When adjusting the receiving frequency, connect the counter to R5 of the MAIN unit through a capacitor. After power adjustment, loosely couple the set to a counter with capability of more than 150MHz (with dummy load connected), so that the transmitting frequency can be obtained.
   - Set thumbwheel switches of the set to 146.000MHz (IC-2E : 145.000MHz).



2. First, adjust +5KHz and turn to 0KHz. Then check again, because these adjustments interact.

MODE	RX.	SIM/TX.	+600 DUP	−600 DUP
5KHz Adj. FREQ.	L 11	L 12	L 13	L 14
	135.310	146.005	146.605	145.405
	IC-2E:134.310	145.005	145.605	144.405
0KHz Adj. FREQ.	L 7	L 8	L 9	L 10
	135.305	146.000	146.600	145.400
	IC-2E:134.305	145.000	145.600	144.400

3. Confirmation
   Check each frequency (including band-edge):
   All frequencies should be within ±500Hz.

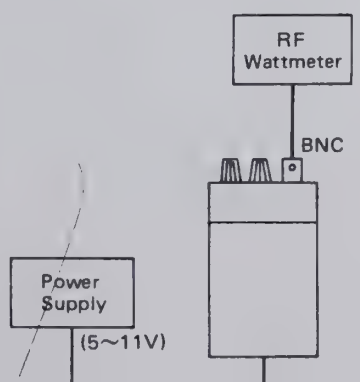
7-5-2 TRANSMISSION

A. Power Adjustment

1. Connection of measuring instruments and setting of the knobs.
   - Connect ANT to 50 ohm power meter.
   - Connect a voltmeter and variable power supply to the set.
     CAUTION: Applying over 10.8V can damage the P.A. transistor.
   - Thumbwheel SW of 2A/2AT to be 146.00MHz.
     Duplex SW shall be in the SIMP position.
   - Power SW shall be HI.

2. Procedure
   - Adjust L19 through L22 of the PLL unit for maximum RF power output while pushing PTT SW.
   - Set the RF Power switch at LOW, and adjust C86 for maximum RF output.
   - Set the RF Power switch at HIGH, and adjust C85 for maximum RF output.
   - Repeat above adjustment procedures until no readjustment of C85 and C86 is required when the RF Power is switched.
   - Set RF Power switch at HIGH, and adjust C90 and C91 for maximum RF output.
   - If the total current drain exceeds 500mA, adjust C91 to set the current at 500mA.
   - In the HIGH power mode, readjust L21 and L22 for maximum RF output.

3. Confirmation
   High Power (rated voltage)
   More than 1.5W, less than 500mA current drain.
   From 144 to 147.99MHz (IC-2E : 145.99MHz) - retune to bring band edge power to minimum if necessary.
   Low Power (rated voltage)
   150mW (+100% −50%), less than 330mA current drain.
   High Power at 7.2V over 1W.
   10.8V over 2.3W.
   No abnormality in operation should be found if the supply voltage is varied from 5.5V to 10.8V.



B. Modulation Adjustment

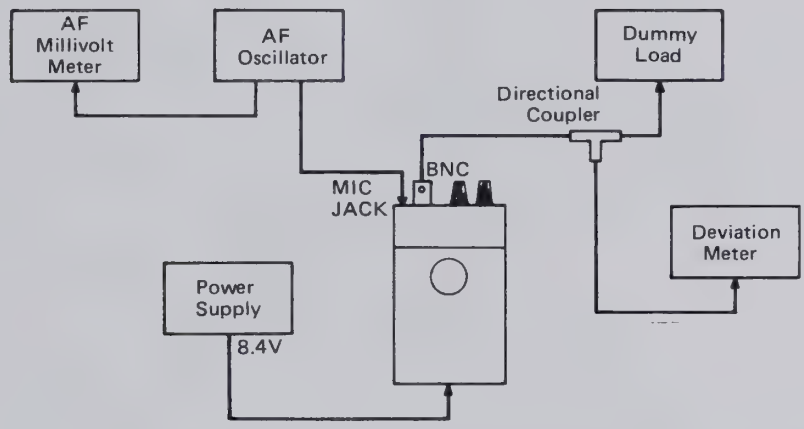
1. Connecting the measuring instrument and the settings of the controls.

   Connect ANT Connector to a deviation meter with a directional coupler or attenuator.

   Deviation meter filter shall be a High Pass Filter 50Hz, L.P.F. 20KHz. De-emphasis OFF.

   - Set thumbwheel SW to 146MHz (IC-2E : 145MHz).
   - Set SIMP/DUP to SIMP.
   - Set Power SW to HI.
   - Connect an AF oscillator, with a millivoltmeter in parallel, to the mic input.

   Insert a switch in series to allow on/off TX switching.



2. Procedure
   Mic input shall be 1KHz 40mV RMS. During TX, adjust R71 on the main unit for 5KHz deviation.

3. Modulation check
   Maximum deviation: With 1KHz 40mV shall be 5KHz ±10%.

   Modulation sensitivity: Mic input voltage 4mV ±3dB at 1KHz. Deviation should be 3.5KHz.

   S/N Ratio:
   Connect the output of the deviation meter to a millivoltmeter. With no audio input to the mic input, take the voltmeter reading. Now insert 1KHz 40mV audio into the mic connector. Take the voltmeter reading. The ratio should be greater than 40dB.

4. Spurious Transmission
   Connect spectrum analyzer with appropriate attenuation. Confirm nearby random spurious signals below fundamental frequency less than –60dB.

   Measure the harmonic wave output, adjust RF-ATT until noise level just appears.

   Should be less than –60dB below the fundamental frequency.

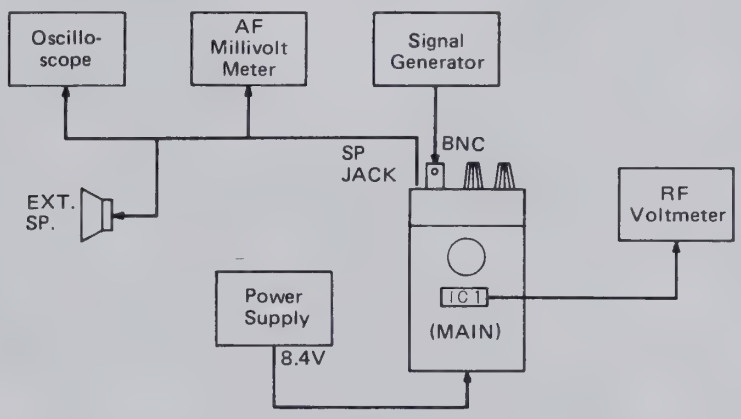
7-5-3 RECEIVER

A. LO Output Adjustment

- Adjust thumbwheel SW to 146MHz (IC-2E : 145MHz). Adjust L17, L18, for maximum output on an RF voltmeter attached to the source of Q3 in the main unit. Output voltage should be about 200mV.

B. RF IF DET Coil Adjustment.

1. The connecting point of measuring instrument and the setting of the knob.
   - Set thumbwheel to 146MHz (IC-2E : 145MHz).
   - Connect antenna to signal generator.
   - Connect SP terminal to EXT SP and AF millivoltmeter.



2. Procedure

   Set RF voltage meter (minimum range) to Pin 16 on IC1 in the IF, adjust L1 through L5 maximum output while setting the input from the signal generator as low as possible. Then vary the input frequency from the signal generator ±10KHz. Check if rippling (change in output level) occurs. If ripple is over 3dB, readjust L5.

   Set signal generator output to −80dBm to −90dBm and deviation to 3.5KHz. Set signal generator frequency to speaker output maximum. After that, adjust L7 for maximum output.

3. Confirmation

   Sensitivity should be less than −8dBμ for 20dB quieting.

C. 2nd LO Frequency Check

Connect a 10.24MHz amplifier to the counter, check the frequency of X1 (2nd OSC) with a loose couple. It should be: 10.240MHz ±400Hz.

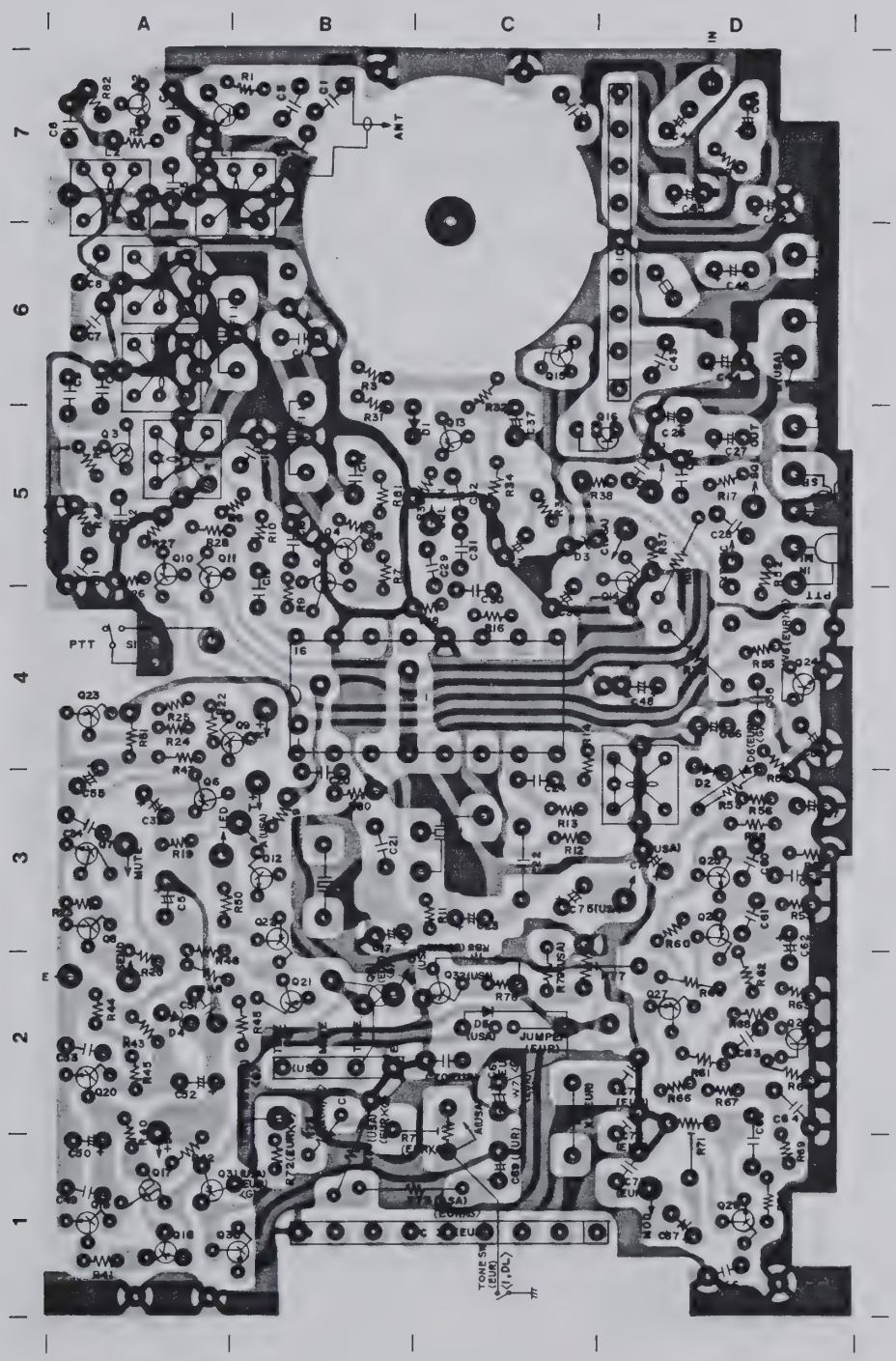
D. Receiver Spurious Response

Connect a speaker and millivoltmeter to the EXT SP. Connect a 50 ohm dummy load to the antenna terminal. All RX spurious should be supressed less than 3dB, over entire frequency range.

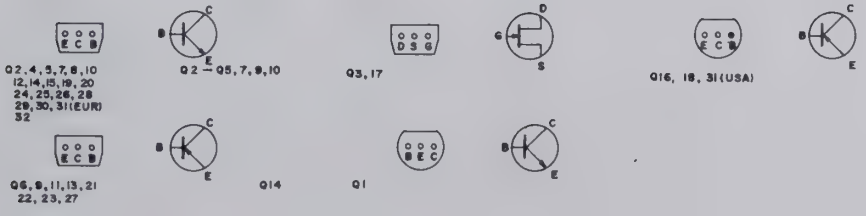
E. Receive Audio Output

Connect to the EXP SP connector a millivoltmeter, oscilloscope, and a distortion meter. To the ANT terminal connect the signal generator and set the signal generator to −80 to −90dBm and deviation to 3.5KHz. Turn up AF VOL control. Read the millivoltmeter when the distortion is 10%.

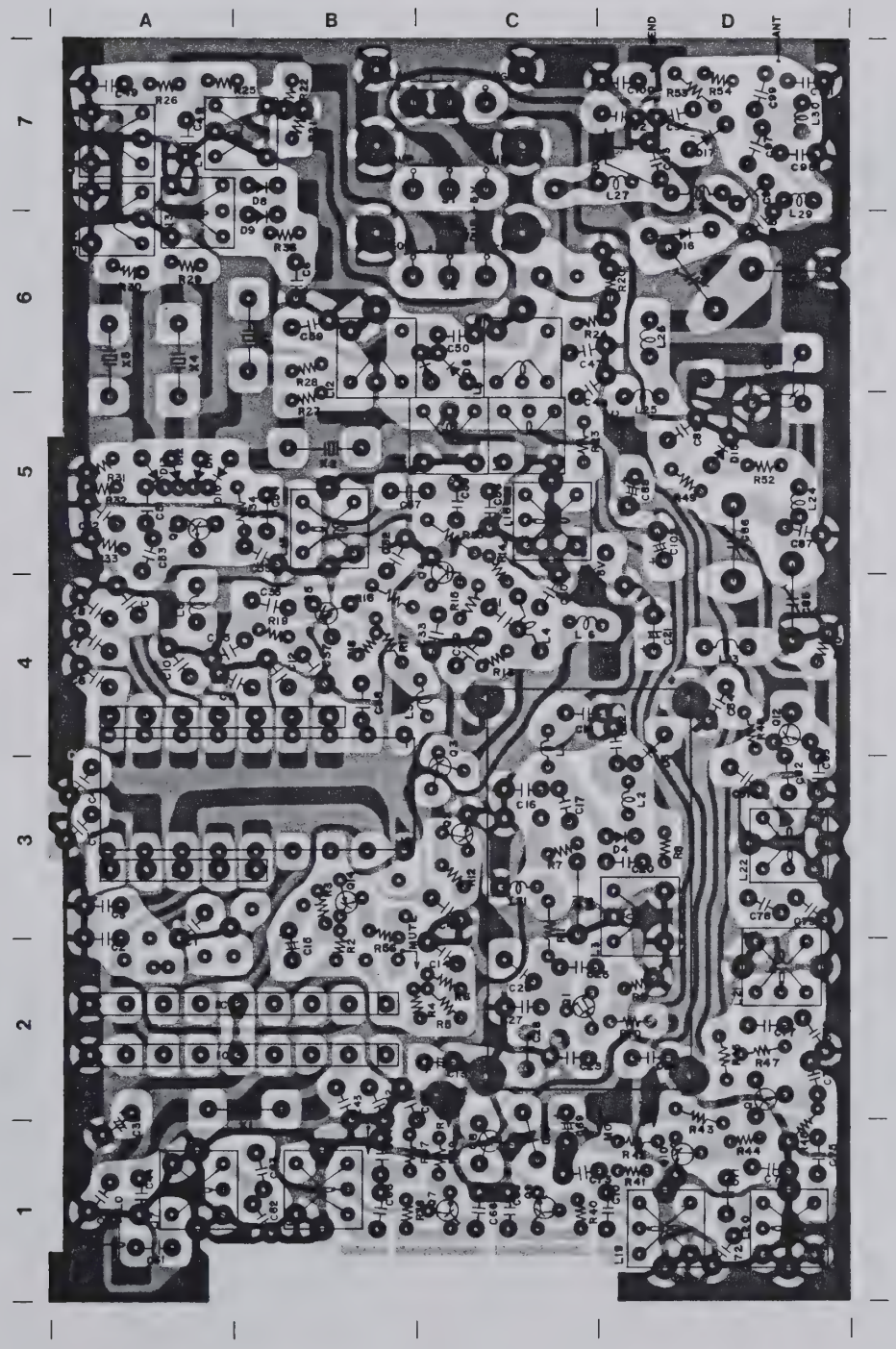
MAIN UNIT

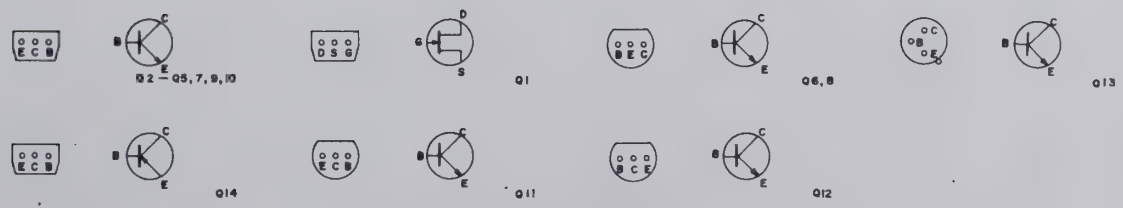


- (USA) → IC-2A/AT ONLY
- (EUR) → IC-2E ONLY



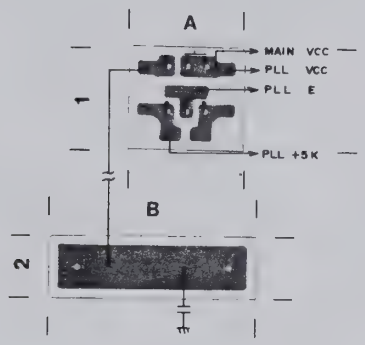
PLL UNIT



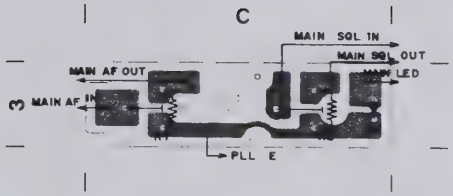


EF UNIT

■ SWITCH BOARD



■ VR BOARD

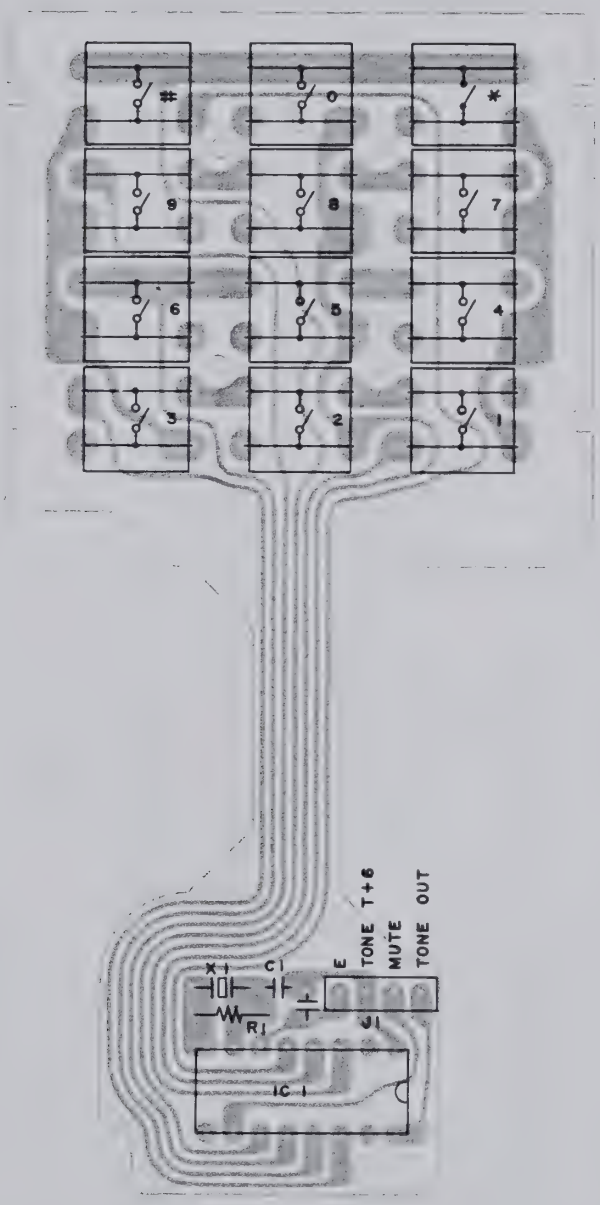


■ BATTERY CONTACT BOARD

■ FLEXIBLE BOARD

TOUCH TONE UNIT

- IC-2AT ONLY



[TOUCH TONE UNIT] (IC-2AT only)

REF. NO.	DESCRIPTION	PART NO.	
IC1	IC	S2559	
X1	Crystal	3.579545MHz HC/43U	
R1	Resistor	1M	R10
C1	Ceramic	10P	50V
C2	Ceramic	0.001	50V
J1	Connector	3024-04CH	
	Key Switch	KHG	
B1	PC Board	B-416C	

SECTION 9 VOLTAGE CHARTS

TRANSISTORS VOLTAGE CHART

• Measuring instrument is a 50KΩ/V multimeter.

UNIT	NO.	TRANSMIT			RECEIVE			REMARKS
		BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	
MAIN	Q 1	0	0	GND	0.75	1.9	GND	RF Amp
	Q 2	0	0	0	2.2	5.5	1.9	RF Amp
	Q 3	0	0	0	0	5.4	1.6	1st Mixer
	Q 4	0	0	GND	0.7	0.9	GND	1st IF Amp
	Q 5	0	0	0	1.6	2.2	0.9	1st IF Amp
	Q 6	4.2	4.8	5.0	4.9	0	5.0	T/R Switch
	Q 7	0	0.7	GND	0	0.3	GND	T/R Switch
	Q 8	0.7	0	GND	0.3	4.1	GND	T/R Switch
	Q 9	4.6	0	5.0	4.2	4.9	5.0	T/R Switch
	Q10	0	7.8	0	4.9	7.8	4.4	T/R Switch
	Q11	7.8	0	8.4	7.8	5.6	8.4	T/R Switch
	Q12	4.8	7.9	4.2	0	8.4	0	
	Q13	0	0.5	0	3.7	1.5/0	2.8/3.4	Noise Detector SQL CLOSED/SQL OPENED
	Q14	0.6	0	GND	0.6/0	0/8.2	GND	Squelch Control
	Q15	0	7.8	0	0/8.2	7.8	0/7.6	Squelch Control
	Q16	7.8	0	8.4	7.8	7.6/0	8.4	T/R Switch
	Q17	0.6	8.4	2.0	0.5	8.4	2.0	Regulator
	Q18	8.2	5.0	8.4	8.4	5.0	8.4	Regulator
	Q19	0.6	8.2	GND	0.5	8.4	GND	Regulator
	Q20	0.6	0.6	GND	0.6	0.5	GND	
	Q21	5.7	3.4	5.0	5.8	0	5.0	Indicator Control
	Q22	3.4	4.0	4.2	0	0	0	Indicator Control
	Q23	4.8	3.8	3.9	3.2	1.3	5.0	
	Q24	0.6	0	GND	0	4.9	GND	Mic Amp Mute Cont.
	Q25	2.4	4.2	2.0	0	0	0	Mic Amp
	Q26	2.6	3.6	2.0	0	0	0	Mic Amp
	Q27	3.6	2.6	4.1	0	0	0	Mic Amp
	Q28	0.6	2.0	GND	0	0	GND	Limiter
	Q29	2.1	4.2	1.9	0	0	0	Low Pass Filter
	Q30	0/4.9	4.4/7.7	2.6/4.9	0/0	0/7.8	0/0	T/R Switch IC-2A/AT only
	Q31	4.4/8.3	8.4/6.1	4.0/8.4	0/8.4	8.4/0	0/8.4	T/R Switch IC-2A/AT only
	Q32	0	0.6	GND	0	0.6	GND	IC-2A 2AT only
	Q33	3.6	4.2	4.2	0	0	0	IC-2E only
PLL	Q 1	0	4.0	0.8	0	4.0	0.75	VCO, FM Mod.
	Q 2	0.7	1.0	GND	0.7	1.0	GND	Buffer Amp
	Q 3	1.6	2.9	1.0	1.6	2.9	1.0	Buffer Amp
	Q 4	0.7	0.7	GND	0.7	0.7	GND	PLL Mixer
	Q 5	1.4	3.4	0.9	1.4	3.4	0.9	Level Converter
	Q 6	1.3	4.9	0.8	1.3	4.9	0.8	Multiplier
	Q 7	0	0	1.5	2.0	4.4	1.7	Multiplier
	Q 8	0.5	1.5	GND	0.5	1.7	GND	Buffer Amp
	Q 9	1.8	4.4	1.5	0	0	1.7	Multiplier
	Q10	0	1.2	GND	0.7	0	GND	
	Q11	1.1	8.0	0.5	0	8.4	0	Buffer Amp
	Q12	0.55	8.4	0.1	0	8.4	0	Driver
	Q13	1.2	8.4	GND	0	8.4	GND	Power Amp
	Q14	4.6	0	5.0	4.6	0	5.0	

IC'S VOLTAGE CHART

- Measuring instrument is a 50KΩ/V multimeter.

IN TRANSMIT MODE

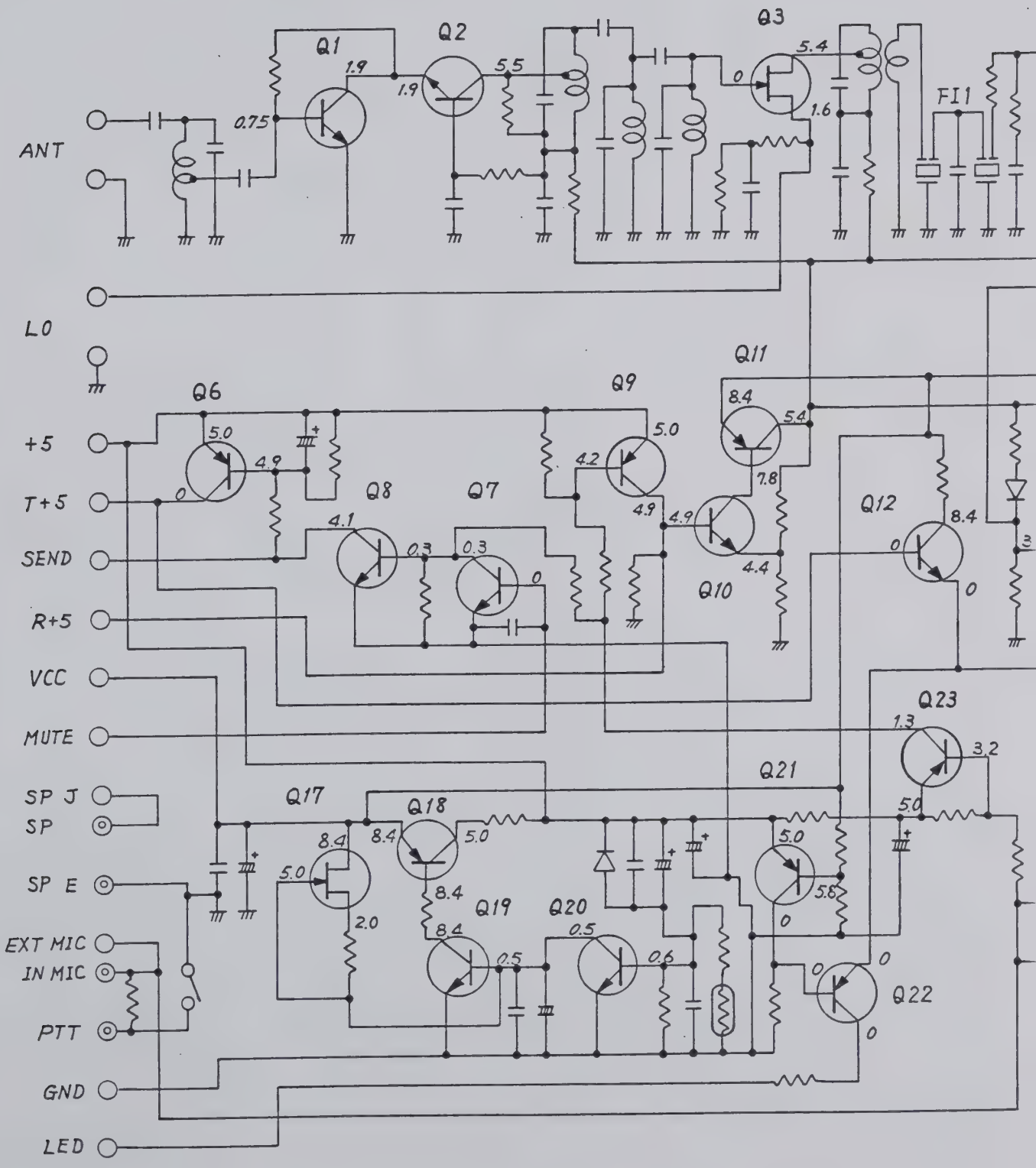
UNIT	IC No.	PIN No.																	REMARKS
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
MAIN	IC1	0	0	0	0	0	0	0	0	0	0	0	GND	0	0	GND	0			
MAIN	IC2	0	0	0	0	GND	0	0	0	0										
MAIN	IC3	0.8	1.4	1.6	1.8	4.0	2.0	2.0	2.0	GND										IC-2E only
PLL	IC1	5.0	1.0	0	0	0	0	0	0	0	0	4.4	0	4.4	0	0	0	0	GND	f = 145MHz
PLL	IC2	0	4.4	1.2	5.0	5.0	0	0	2.4	GND										
PLL	IC3	0.9	1.4	1.8	0	5.0	0	2.4	2.4	GND										
TOUCH TONE	IC1	6.1	5.7	6.1	6.1	6.1	GND	0	6.1	6.1	0	0	0	0	0	4.4	0			IC-2AT only

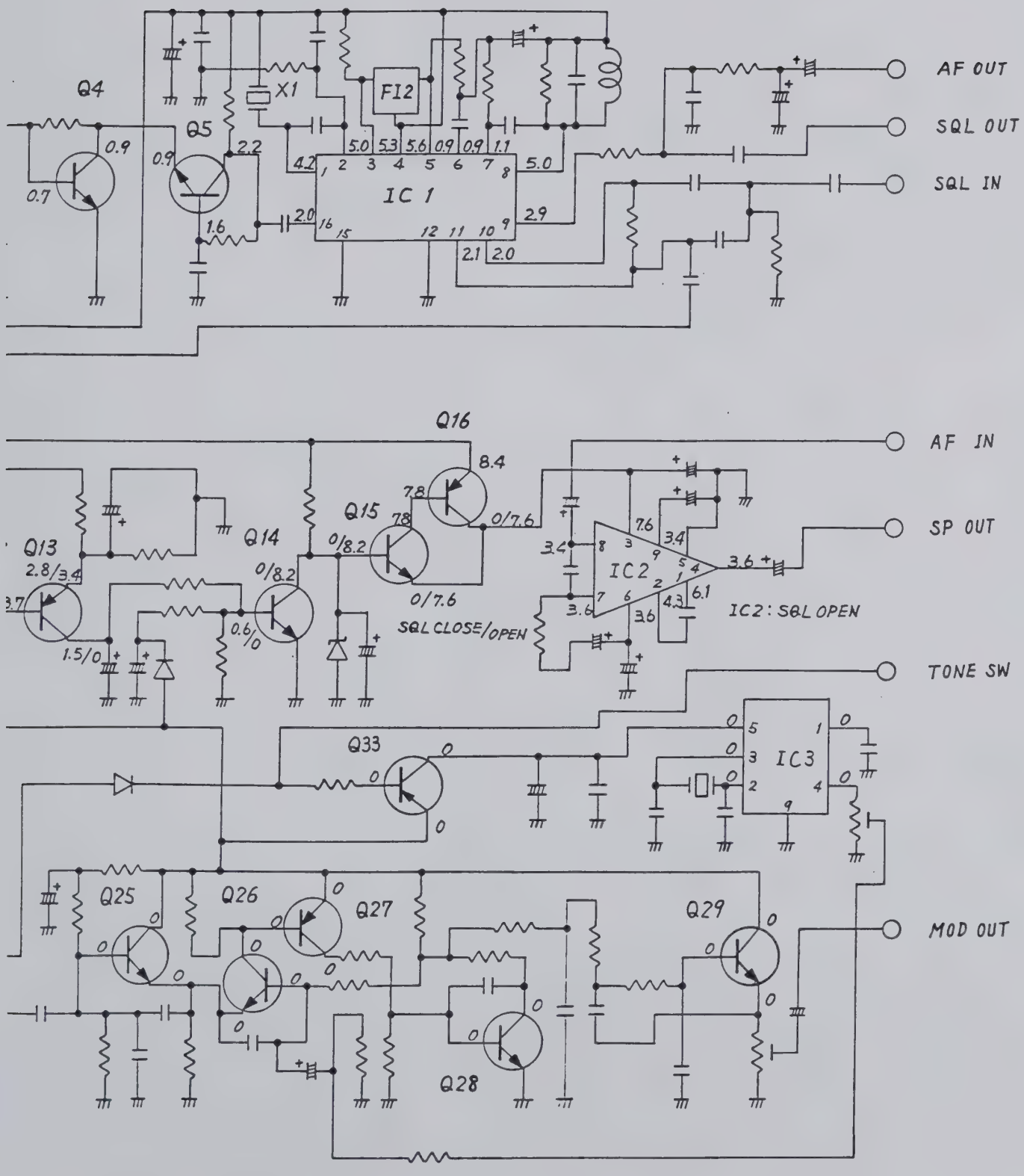
IN RECEIVE MODE

UNIT	IC No.	PIN No.																	REMARKS
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
MAIN	IC1	4.2	5.0	5.3	5.6	0.9	0.9	1.1	5.6	2.9	2.0	2.1	GND	5.1	0	GND	2.0			
MAIN	IC2	6.1	4.3	7.6	3.6	GND	3.6	3.6	3.4	3.4										SQL OPEN
MAIN	IC3	0	0	0	0	0	0	0	0	GND										IC-2E only
PLL	IC1	5.6	1.0	0	0	0	0	0	0	0	0	4.4	0	4.4	0	0	0	0	GND	f = 145MHz
PLL	IC2	0	4.4	1.2	5.0	5.0	0	0	2.4	GND										
PLL	IC3	0.9	1.4	1.8	0	5.0	0	2.4	2.4	GND										
TOUCH TONE	IC1	0	0	0	0	0	GND	0	0	0	0	0	0	0	0	0	0			IC-2AT only

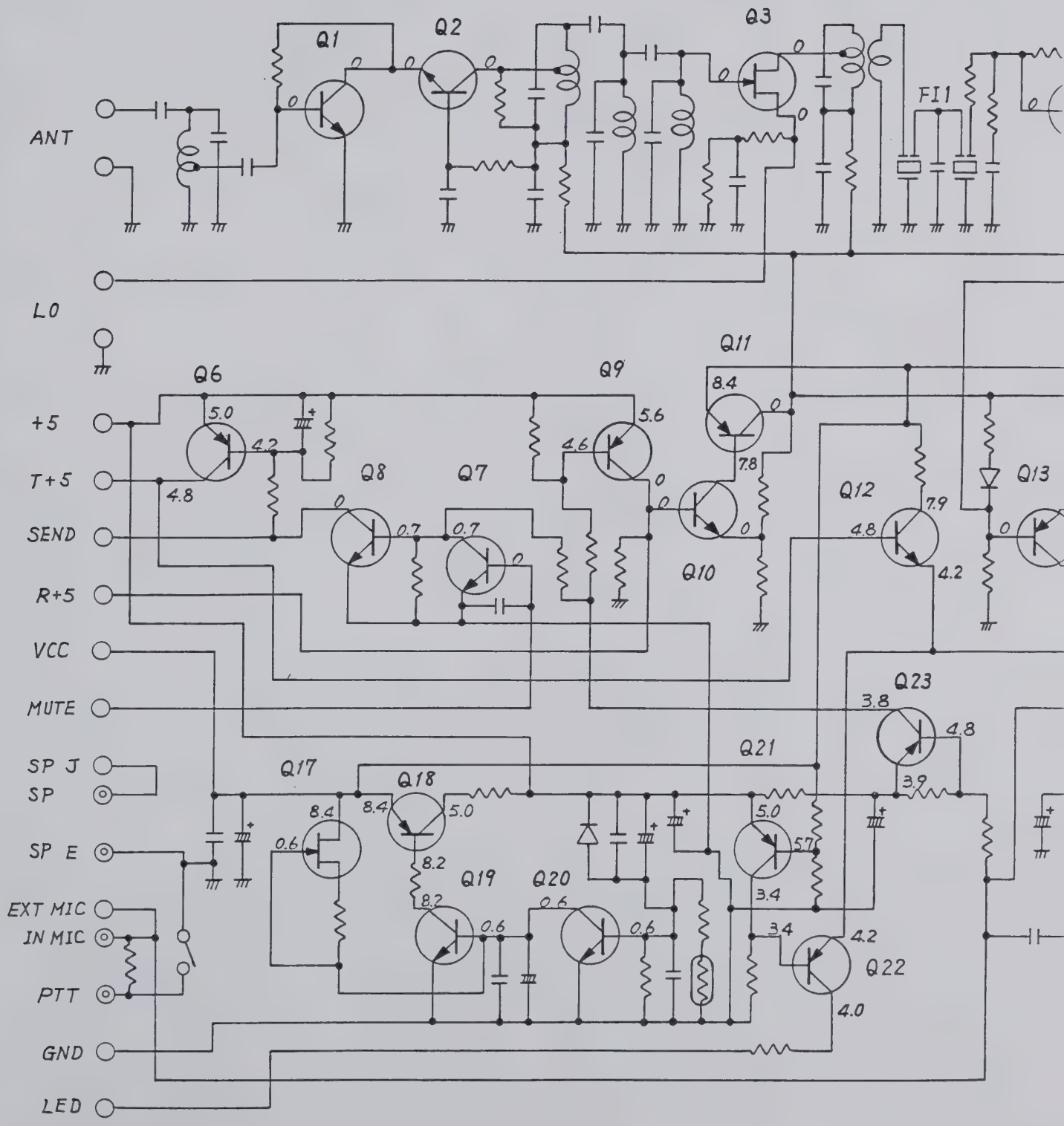
1/2A

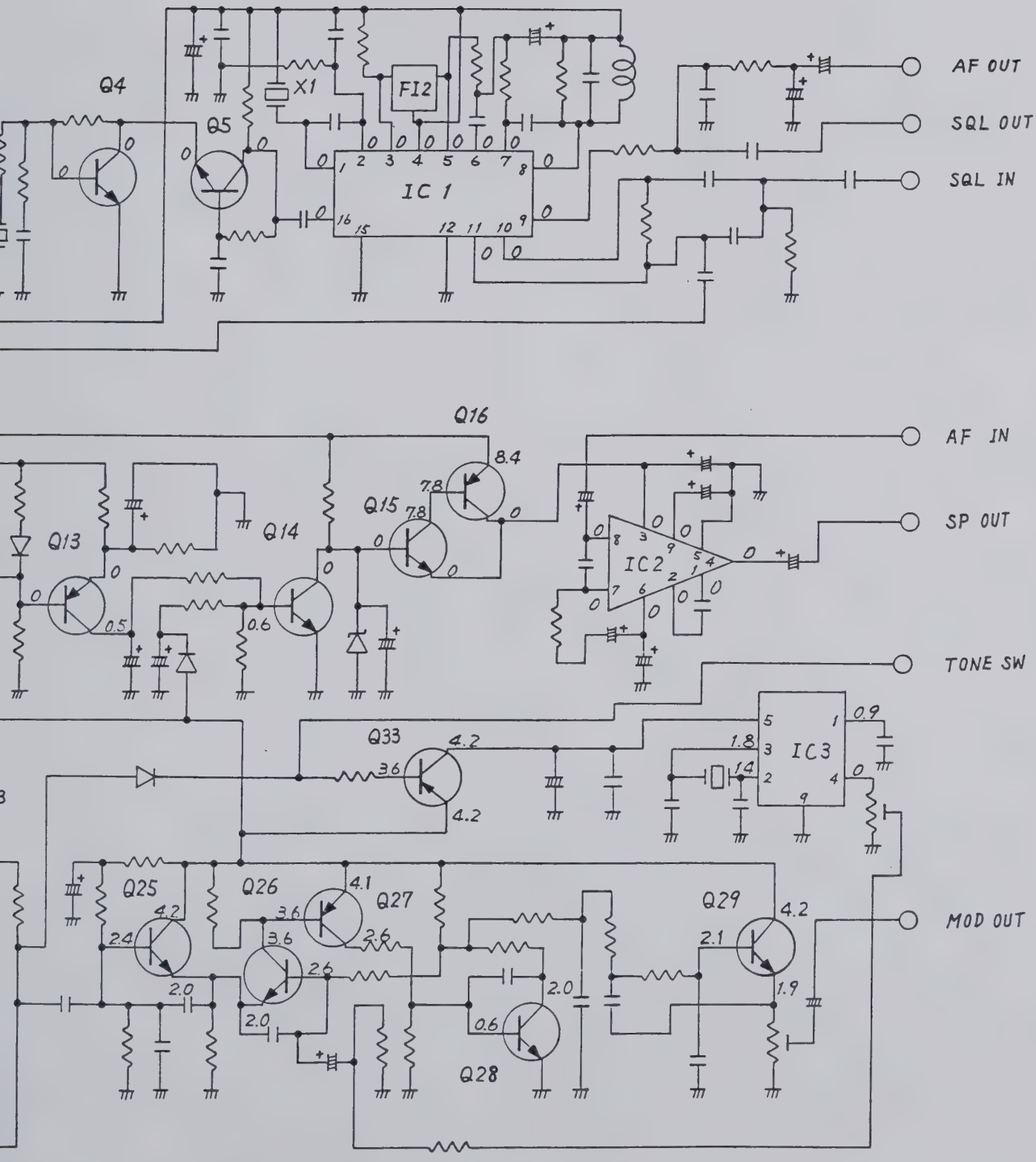
IC-2E MAIN UNIT VOLTAGE CHART (RECEIVE)




Q4
Q5
X1
FI2
IC 1
AF OUT
SQL OUT
SQL IN
Q16
Q15
Q14
Q13
IC2
IC2 : SQL OPEN
SQL CLOSE/OPEN
AF IN
SP OUT
TONE SW
Q33
IC3
Q25
Q26
Q27
Q28
Q29
MOD OUT

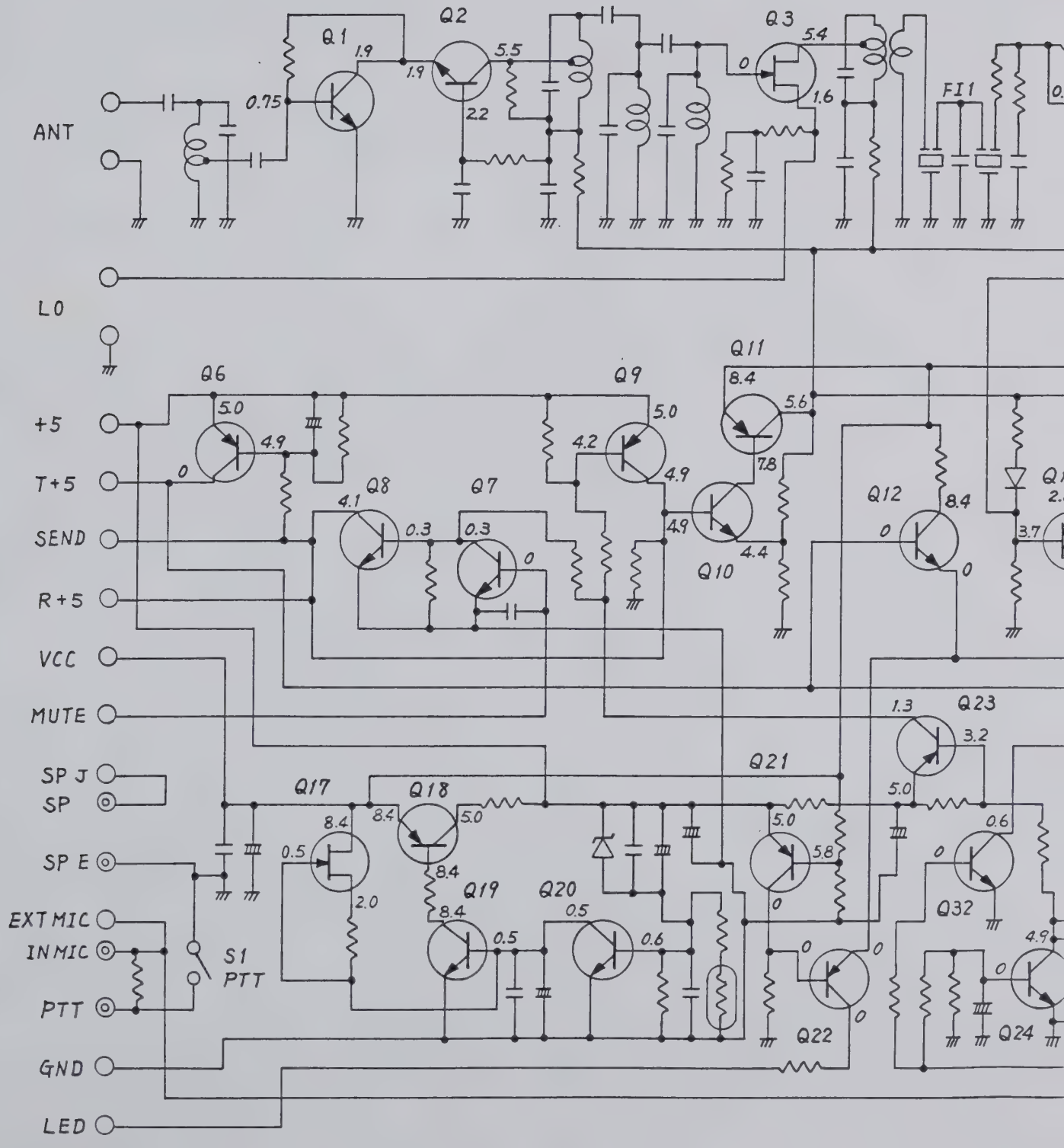
IC-2E MAIN UNIT VOLTAGE CHART (TRANSMIT)

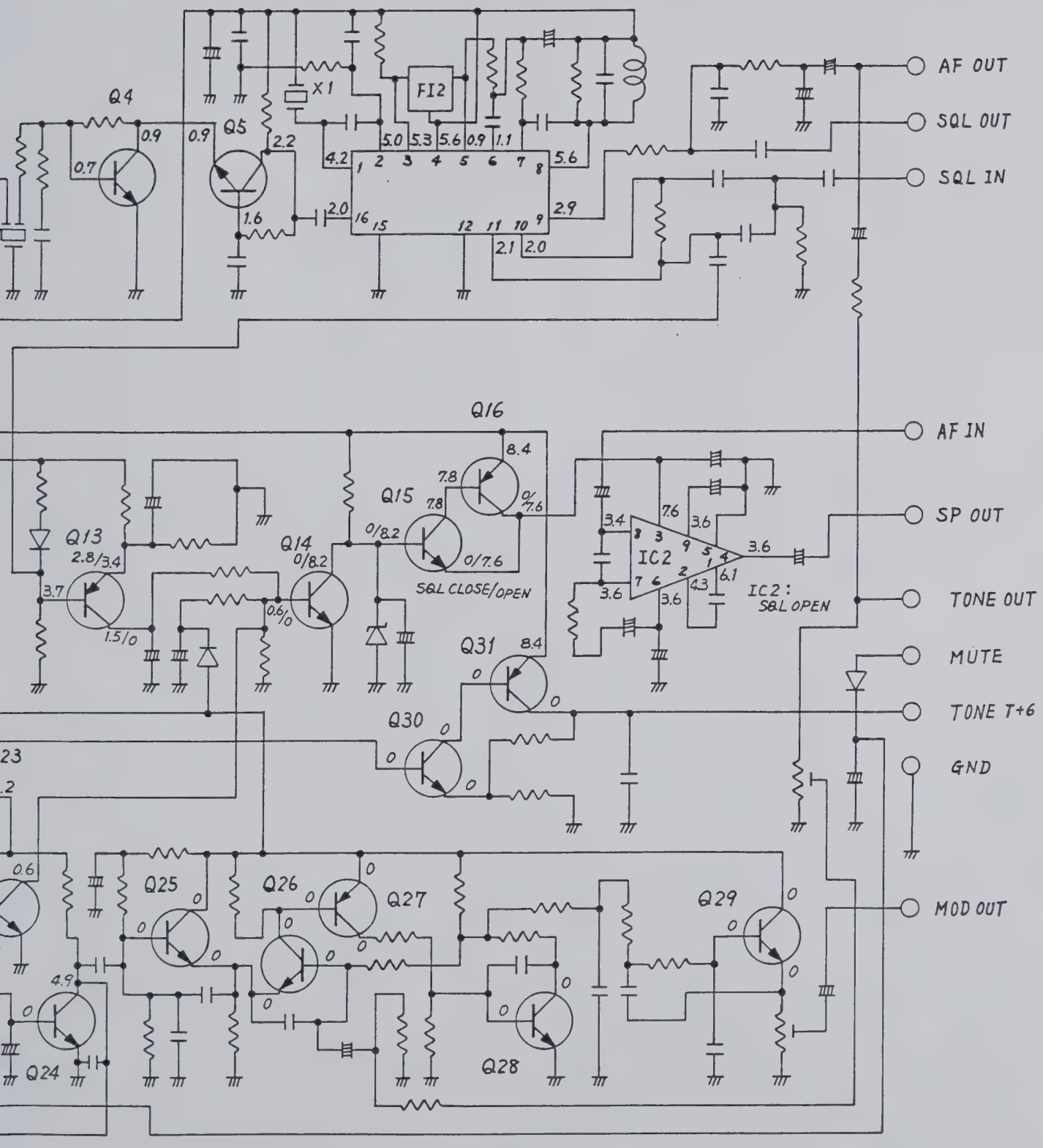



Q4
Q5
X1
FI2
IC 1
AF OUT
SQL OUT
SQL IN
Q16
Q13
Q14
Q15
IC2
AF IN
SP OUT
TONE SW
Q33
IC3
Q25
Q26
Q27
Q28
Q29
MOD OUT

1/2c

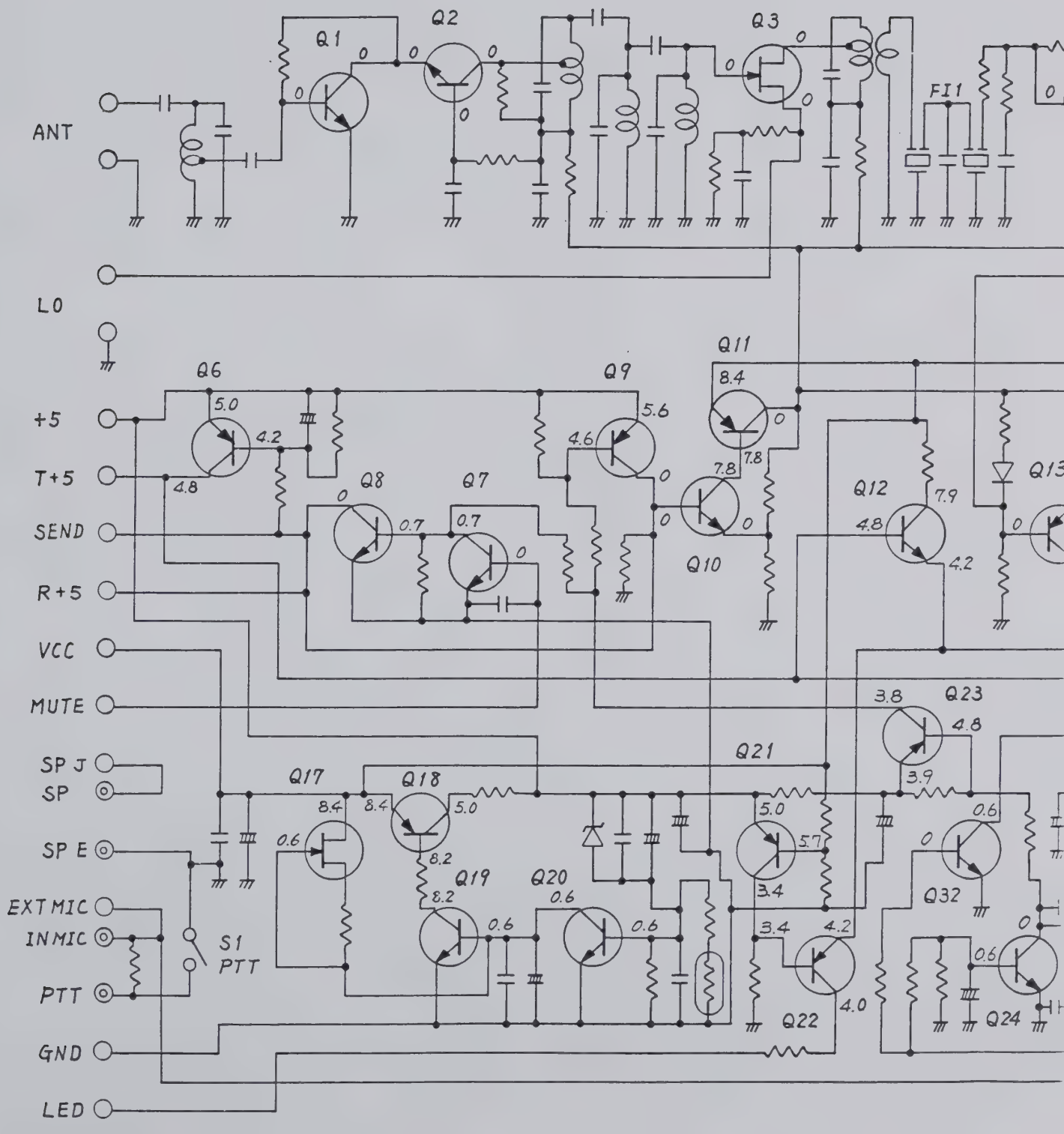
IC-2A MAIN UNIT VOLTAGE CHART (TRANSMIT)

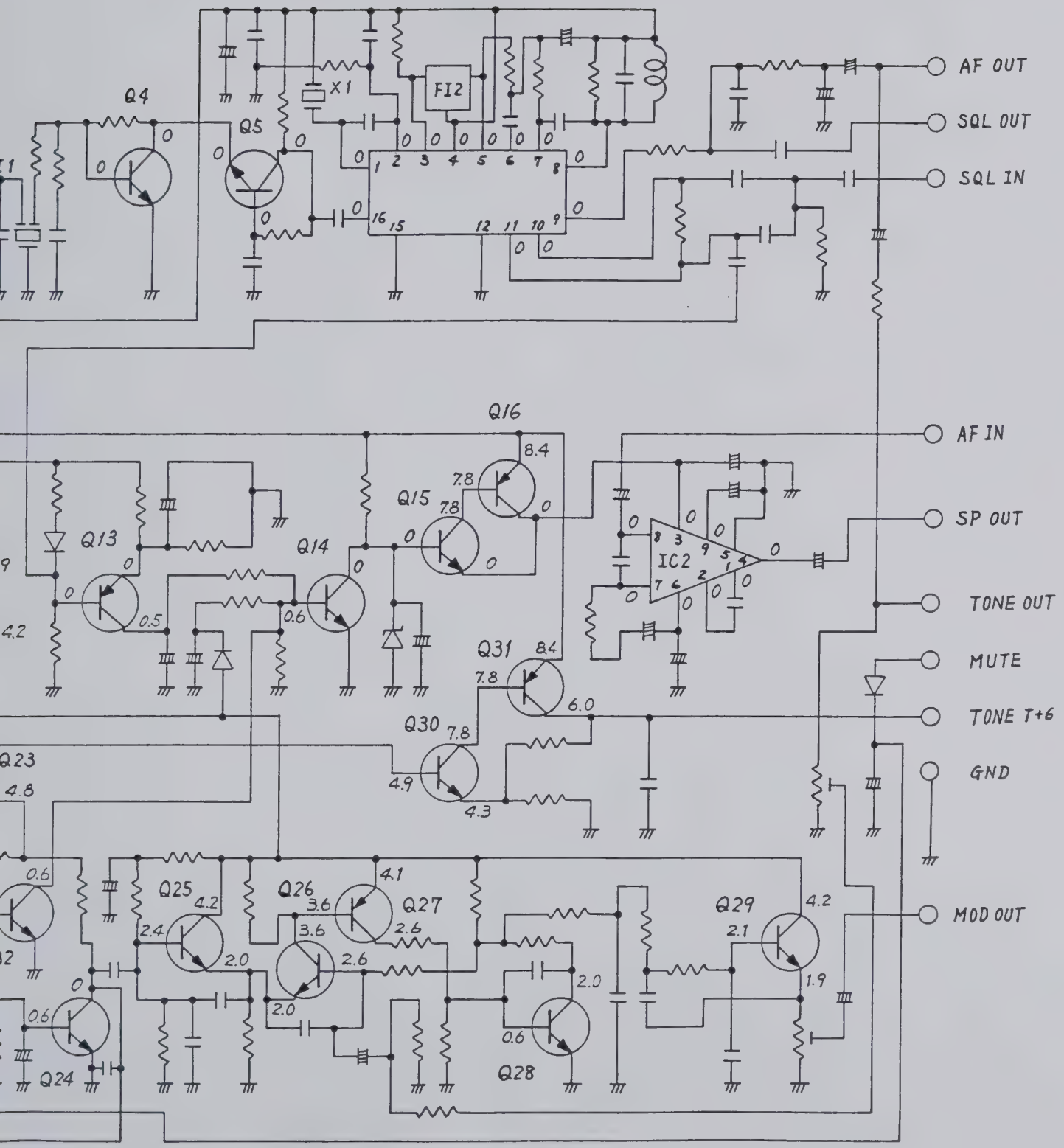



AF OUT
SQL OUT
SQL IN
AF IN
SP OUT
TONE OUT
MUTE
TONE T+6
GND
MOD OUT
Q4
Q5
X1
FI2
Q16
Q15
Q13
Q14
Q31
Q30
Q25
Q26
Q27
Q29
Q28
Q24
IC2
IC2 : SQL OPEN
SQL CLOSE/OPEN

1/2
D

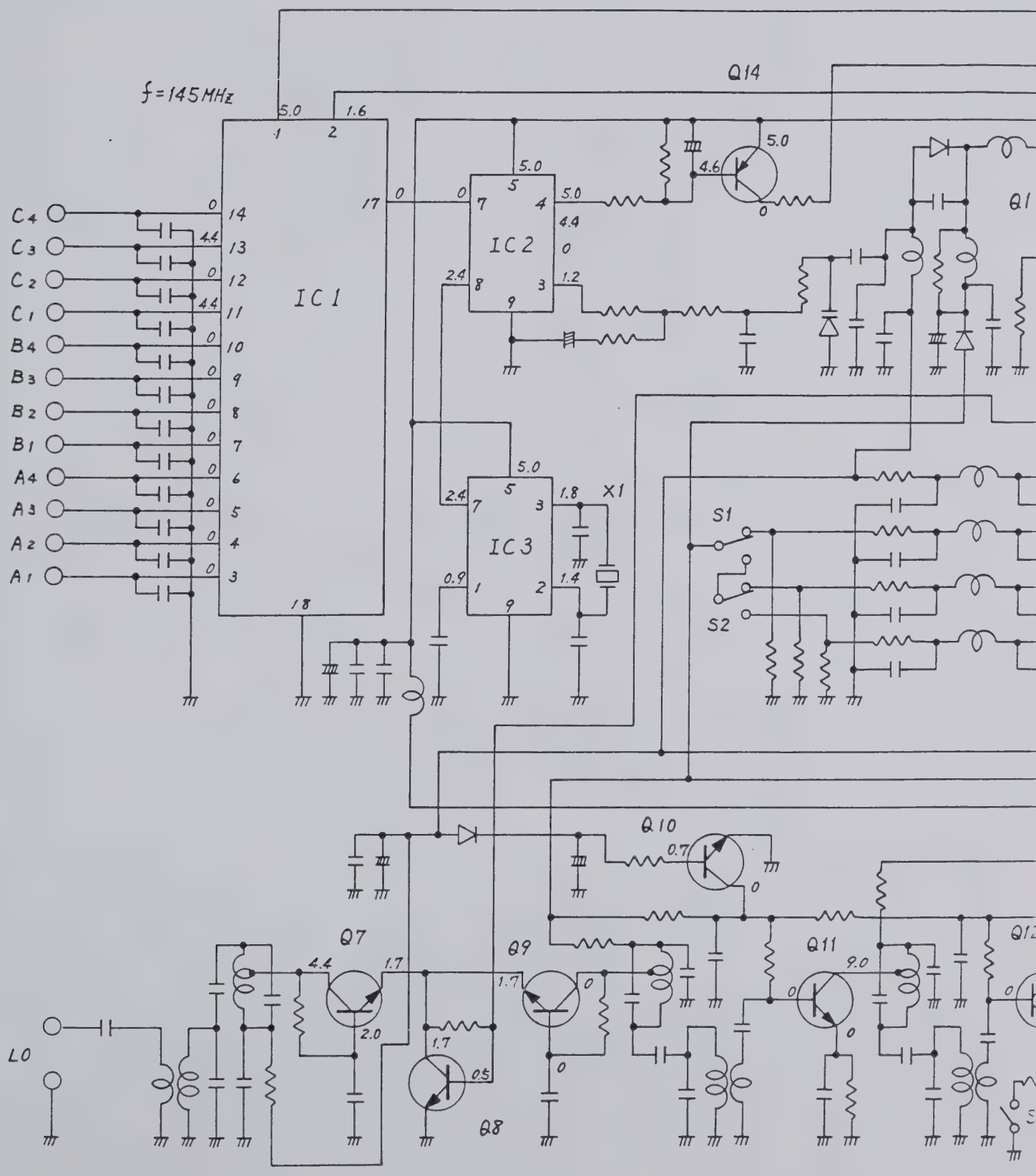
IC-2A MAIN UNIT VOLTAGE CHART (TRANSMIT)



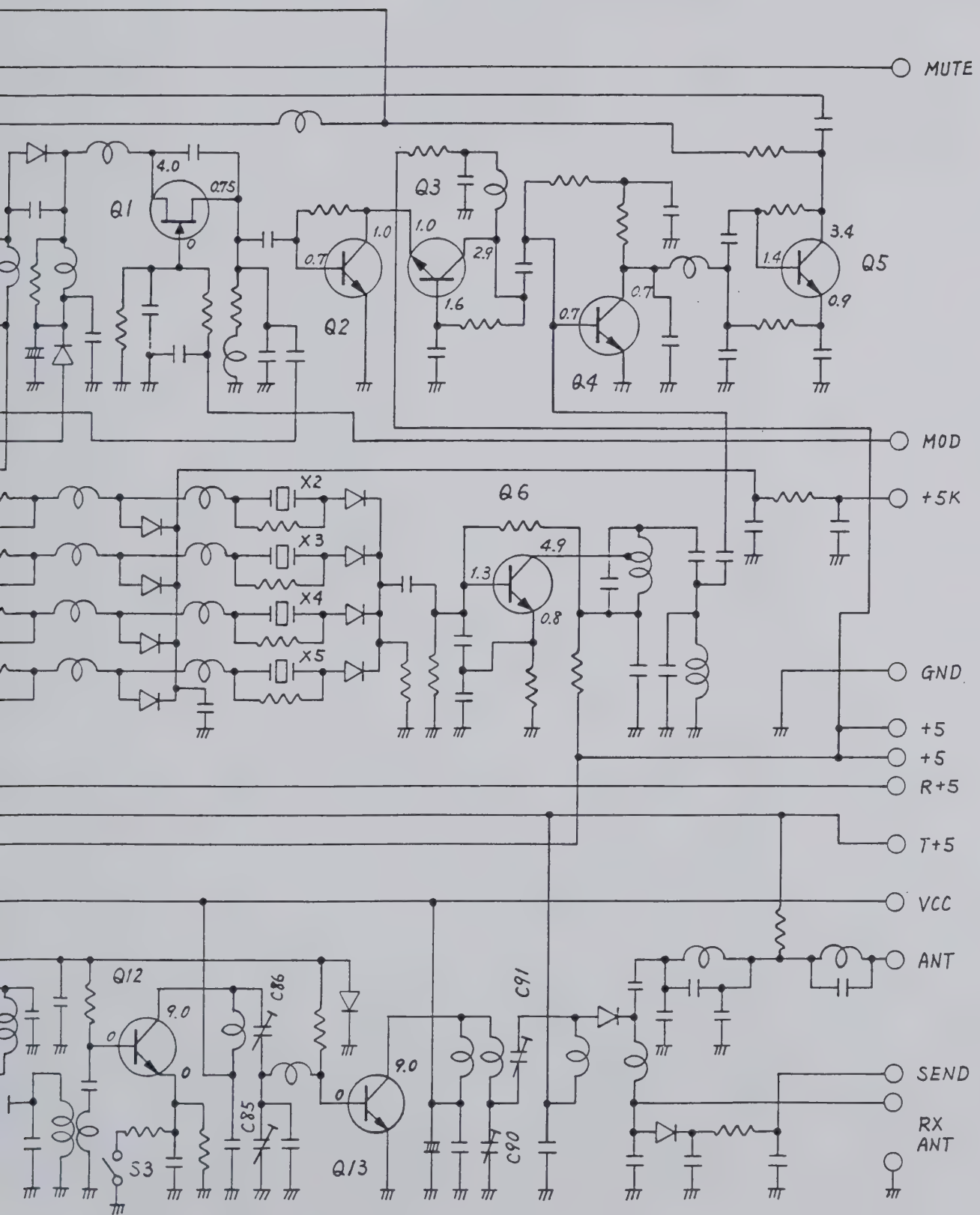

AF OUT
SQL OUT
SQL IN
AF IN
SP OUT
TONE OUT
MUTE
TONE T+6
GND
MOD OUT
Q4
Q5
X1
FI2
Q16
Q15
Q14
Q13
Q31
Q30
IC2
Q23
Q25
Q26
Q27
Q29
Q28
Q24

11/2 E

PLL UNIT VOLTAGE CHART (RECEIVE)

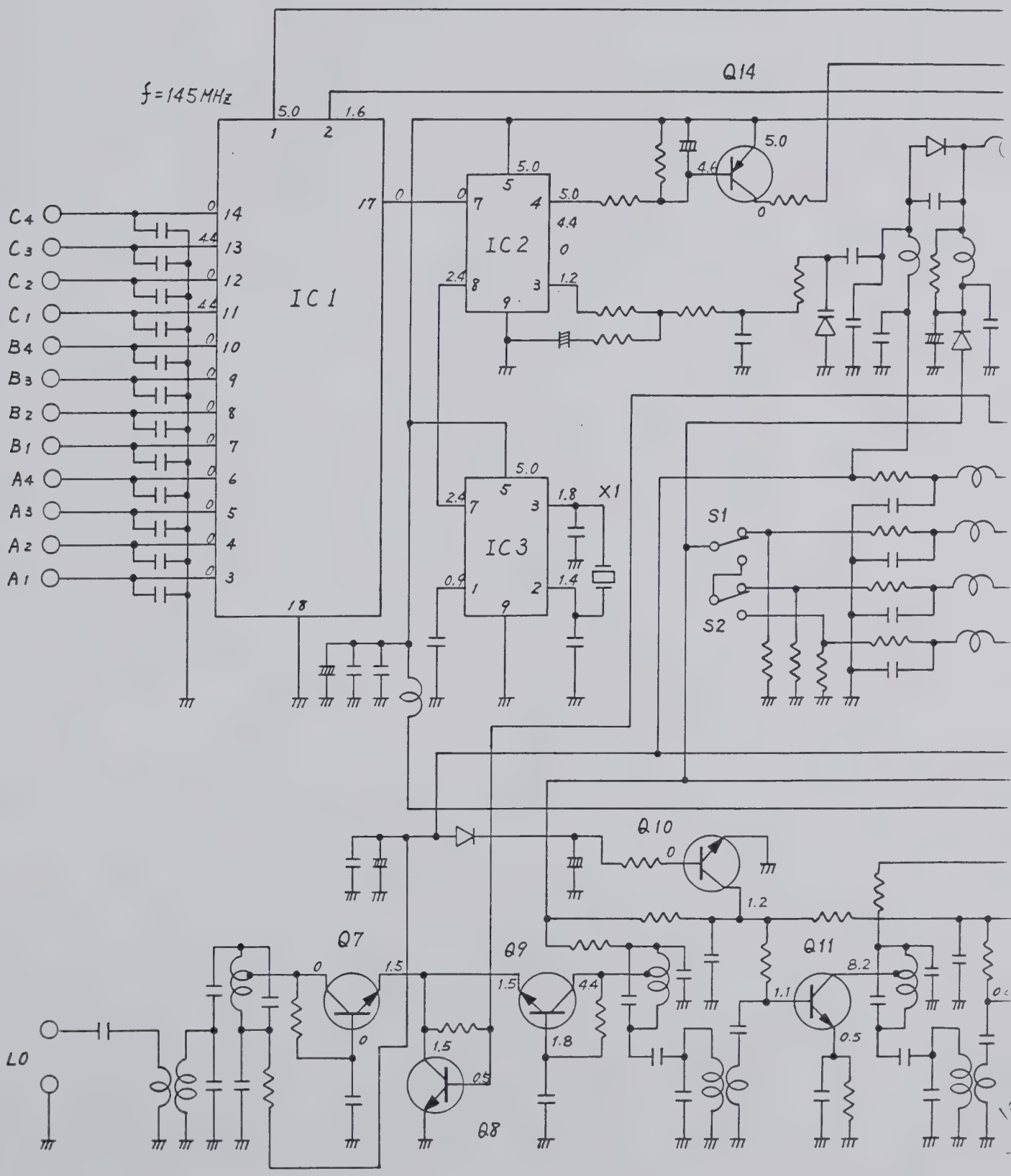


2/2 E

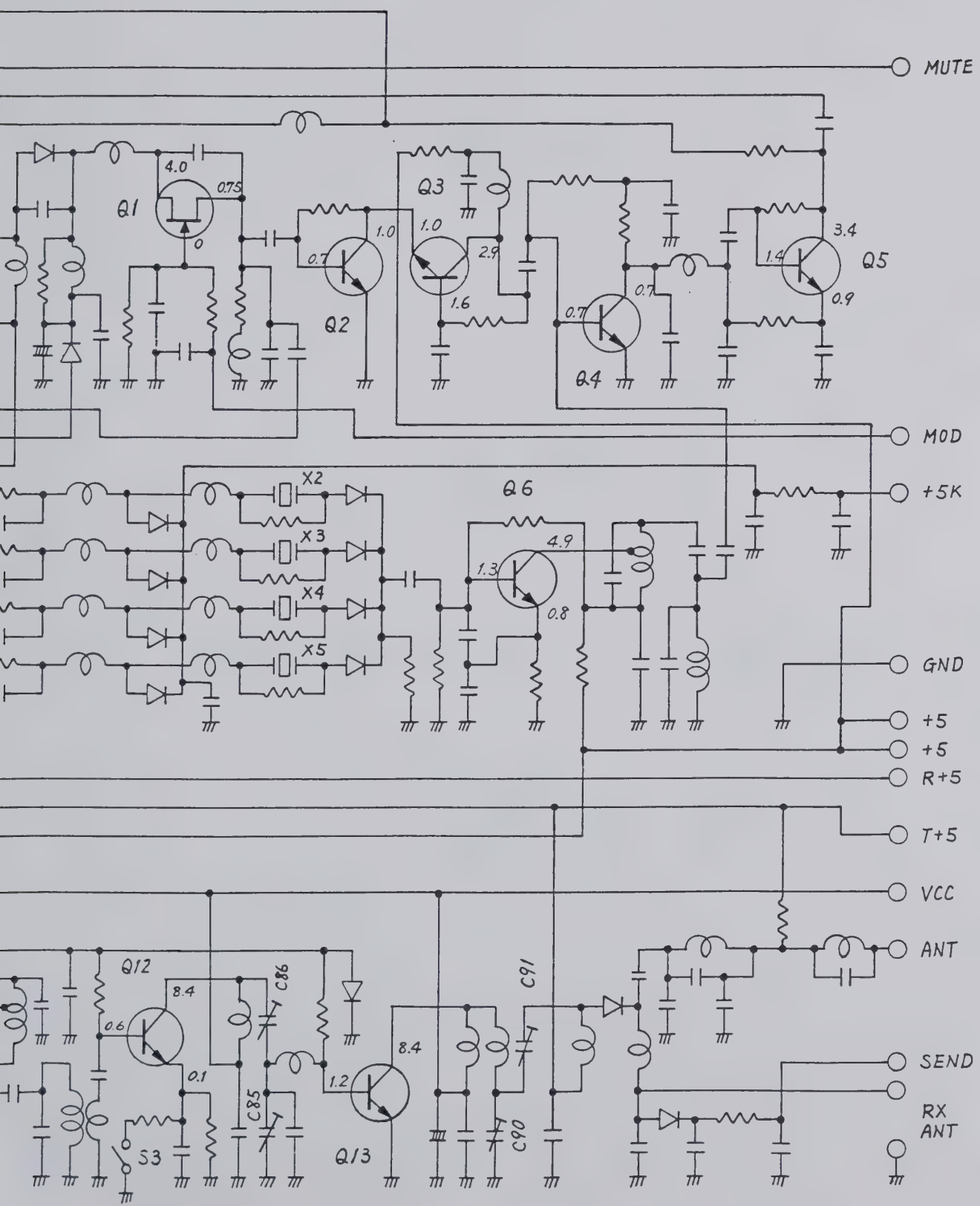

MUTE
MOD
+5K
GND
+5
+5
R+5
T+5
VCC
ANT
SEND
RX ANT
Q1
Q2
Q3
Q4
Q5
Q6
Q12
Q13
X2
X3
X4
X5
C85
C86
C90
C91
S3
4.0
0.75
0
1.0
0.7
1.0
2.9
1.6
0.7
0.7
3.4
1.4
0.9
4.9
1.3
0.8
9.0
0
9.0
0

1/2 F

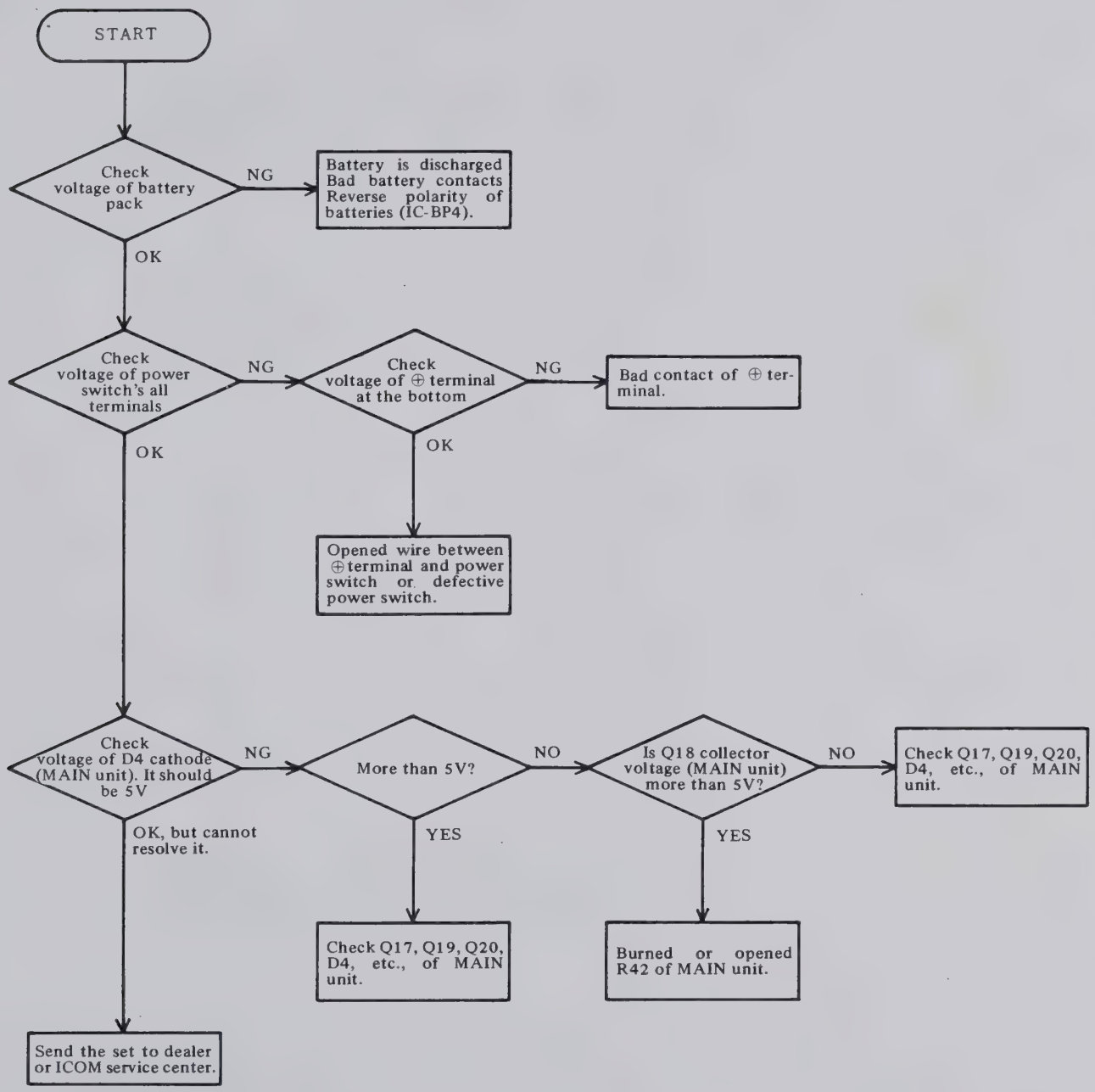
PLL UNIT VOLTAGE CHART (TRANSMIT)



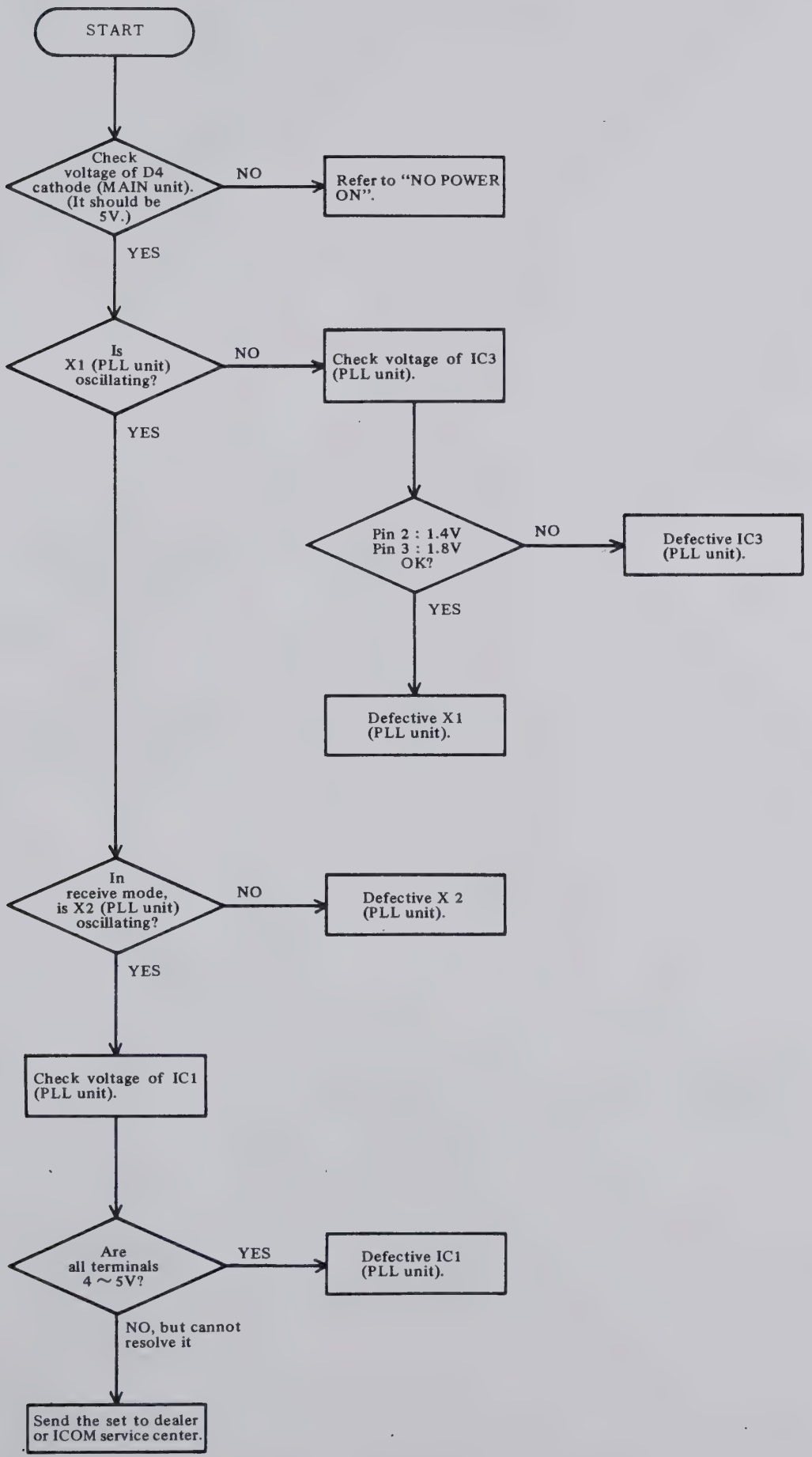
2/2 F


MUTE
MOD
+5K
GND
+5
+5
R+5
T+5
VCC
ANT
SEND
RX ANT
Q1
Q2
Q3
Q4
Q5
Q6
Q12
Q13
X2
X3
X4
X5
S3
C85
C86
C90
C91
4.0
0.75
0
1.0
0.7
1.0
2.9
1.6
0.7
0.7
3.4
1.4
0.9
4.9
1.3
0.8
8.4
0.6
0.1
8.4
1.2

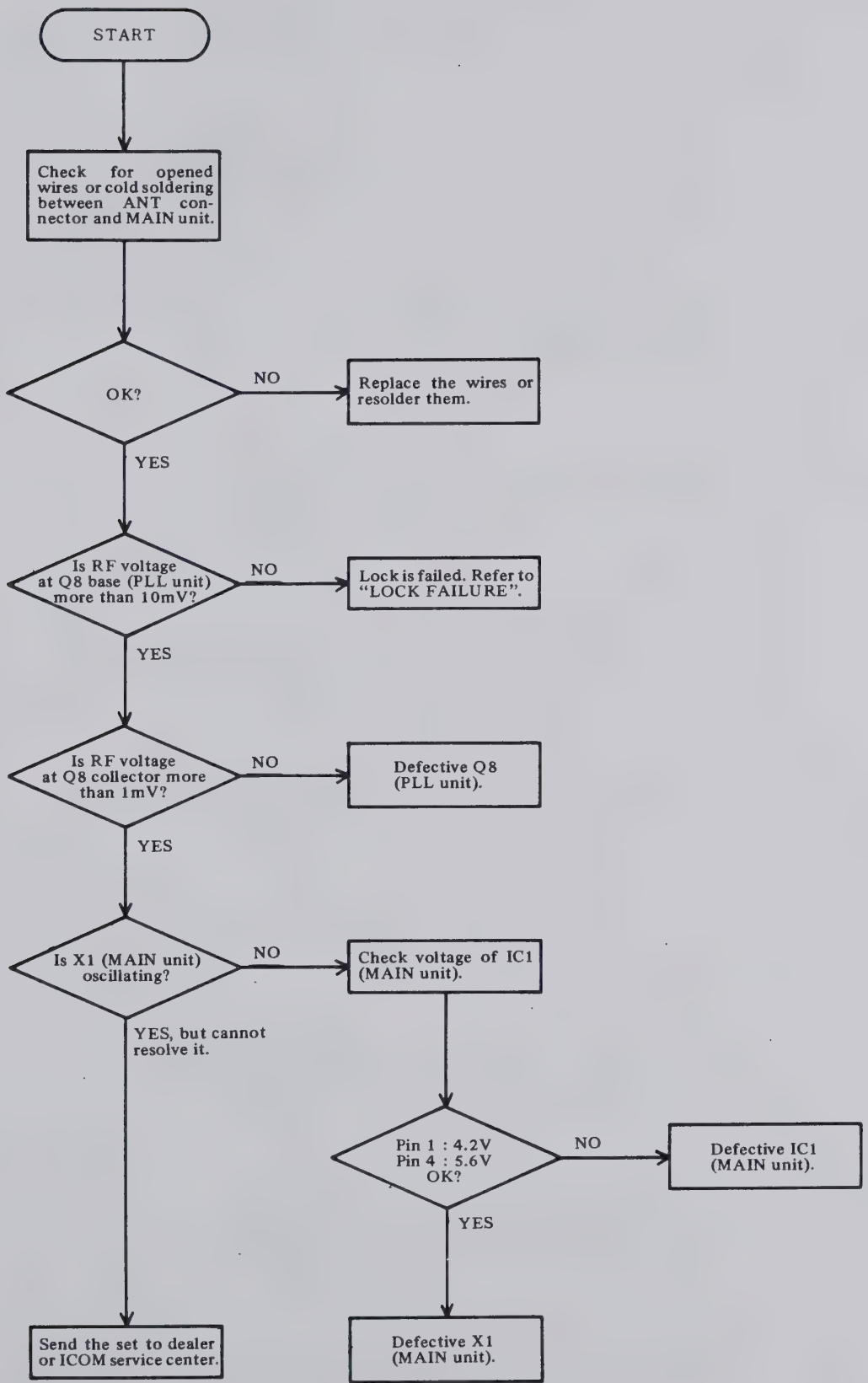
NO POWER ON


START
Check voltage of battery pack
NG
Battery is discharged
Bad battery contacts
Reverse polarity of batteries (IC-BP4).
OK
Check voltage of power switch's all terminals
NG
Check voltage of ⊕ terminal at the bottom
NG
Bad contact of ⊕ terminal.
OK
OK
Opened wire between ⊕ terminal and power switch or defective power switch.
Check voltage of D4 cathode (MAIN unit). It should be 5V
NG
More than 5V?
NO
Is Q18 collector voltage (MAIN unit) more than 5V?
NO
Check Q17, Q19, Q20, D4, etc., of MAIN unit.
OK, but cannot resolve it.
YES
YES
Check Q17, Q19, Q20, D4, etc., of MAIN unit.
Burned or opened R42 of MAIN unit.
Send the set to dealer or ICOM service center.

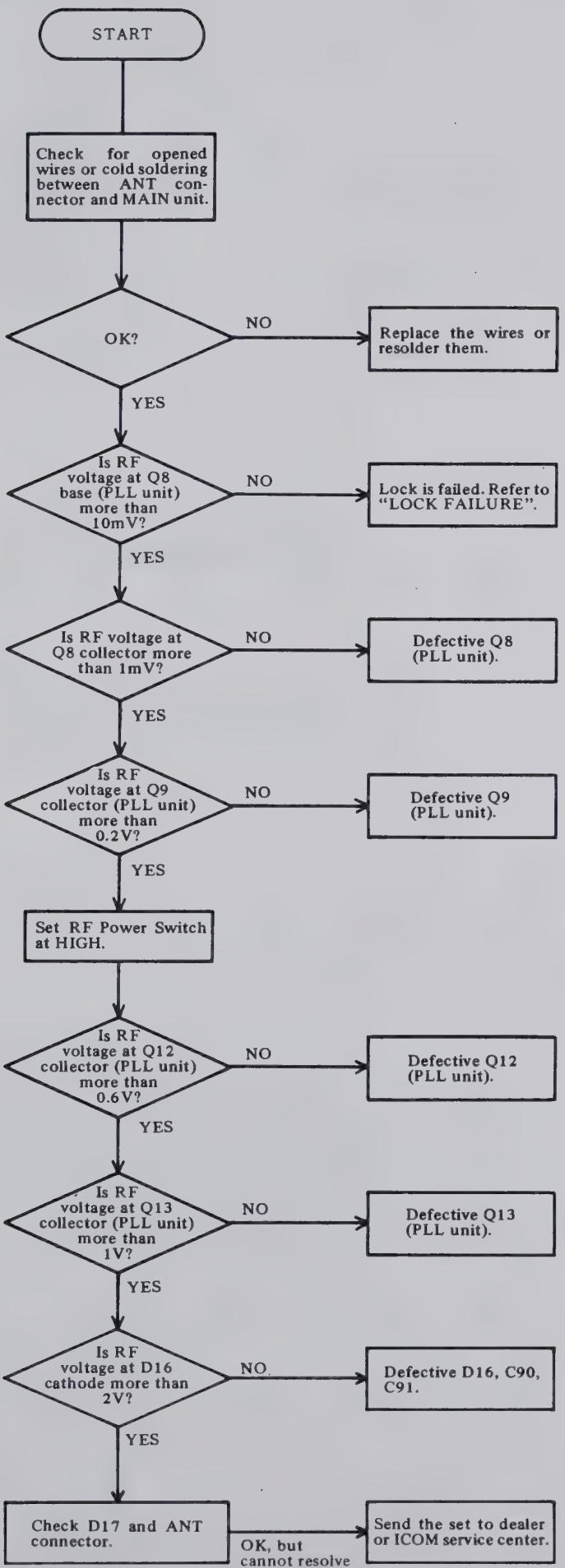
LOCK FAILURE



NO RECEPTION



NO TRANSMIT RF POWER

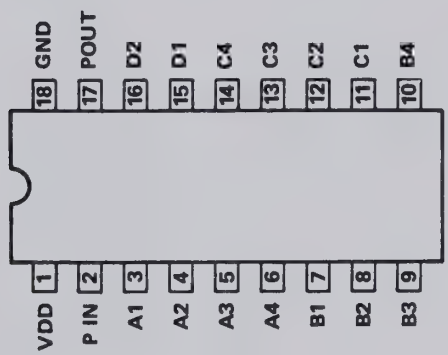


TC-9122P (BCD PROGRAMMABLE COUNTER)

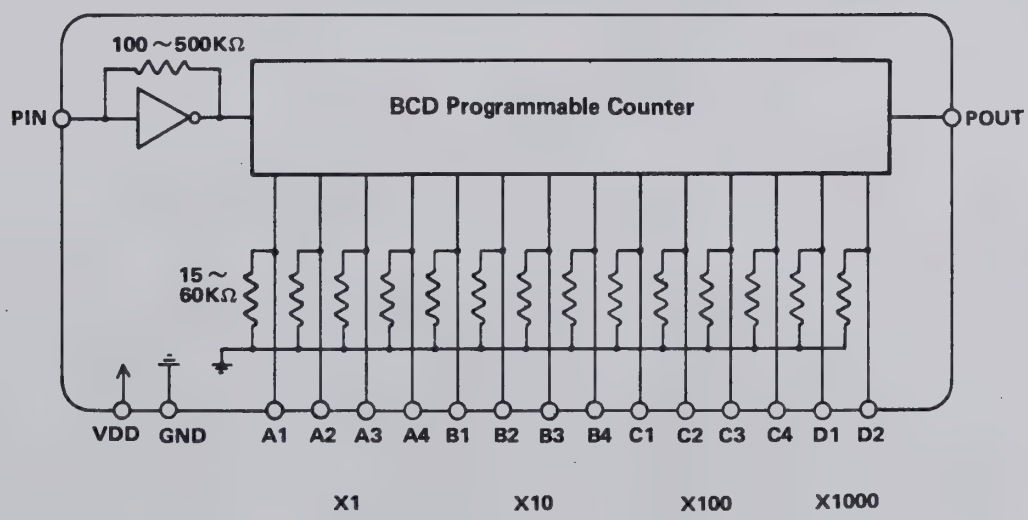
MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	10	V
V_{IN}	Input Voltage	−0.3 ~ V_{DD} +0.3	V
T_{OPR}	Operating Temperature	−30 ~ 75	°C
T_{STR}	Storage Temperature	−55 ~ 125	°C

PIN CONNECTION



BLOCK DIAGRAM

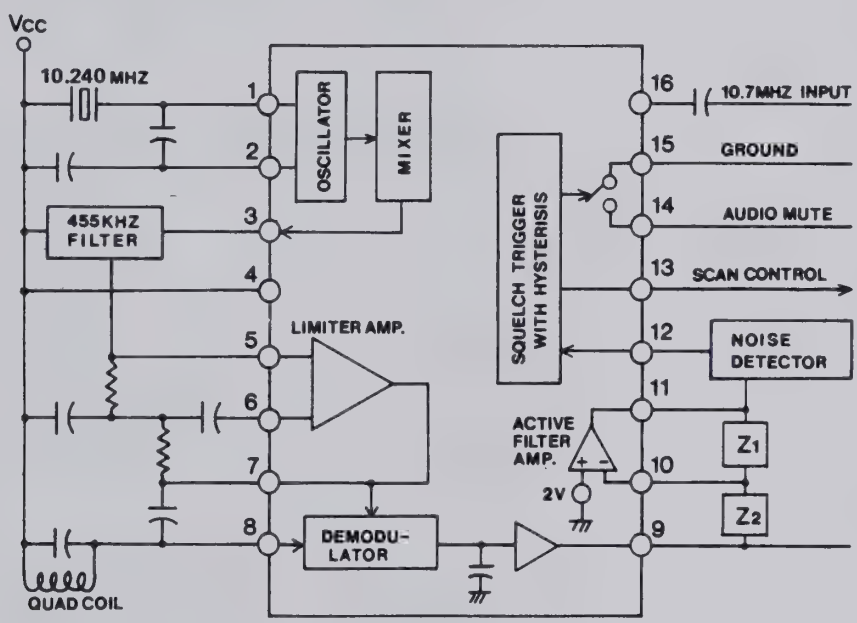


MC-3357 (LOW POWER FM IF)

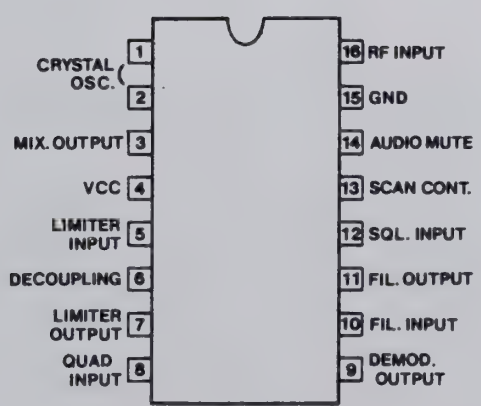
MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VCC	Supply Voltage (MAX)	12	VDC
VCC	Operating Supply Voltage	4 to 8	VDC
VIN	Input Voltage	1.0	VRMS
TOPR	Operating Temperature	−30 ~ +70	°C
TSTG	Storage Temperature	−65 ~ +150	°C

BLOCK DIAGRAM



PIN CONNECTION

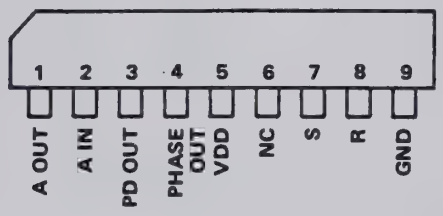


TC-5081 (PHASE COMPARATOR)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VDD	Supply Voltage	10	V
VIN	Input Voltage	–0.3 ~ VDD +0.3	V
TOPR	Operating Temperature	–30 ~ 75	°C
TSTR	Storage Temperature	–55 ~ 125	°C

PIN CONNECTION

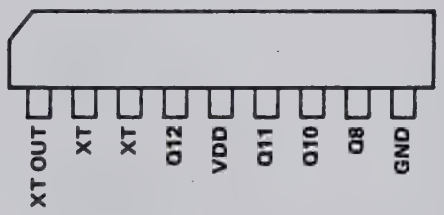


TC-5082 (OSCILLATOR AND 10 STAGE DIVIDER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VDD	Supply Voltage	10	V
VIN	Input Voltage	–0.3 ~ VDD +0.3	V
TOPR	Operating Temperature	–30 ~ 75	°C
TSTR	Storage Temperature	–55 ~ 125	°C

PIN CONNECTION

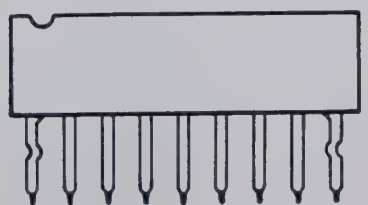


BA-526 (700mW AMPLIFIER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VCC	Supply Voltage	9	V
Pd	Permissible Dissipation	700	mW
TOPR	Operating Temperature	–10 ~ +65	°C
TSTG	Storage Temperature	–30 ~ +125	°C

PIN CONNECTION



SECTION 12 PARTS LIST

[EF UNIT]

REF. NO.	DESCRIPTION	PART NO.
D1	LED	SLC-26UR
R1	Variable	VR10R10KA (IC-2A/AT) VN24R-5N4111-10KA (IC-2E)
R2	Variable	VR10R10KB
C1	Ceramic	470P 50V
C2	Ceramic	470P 50V
C3	Ceramic	15P 50V
J1	Connector	BNC-RM
J2	Connector	HSJ0296-01-150
J3	Connector	HSJ0289-01-050
S1	Switch	A7MA-206-P2
S2	Switch	HSW0567-01-310
S3	Switch	HSW0567-01-310
SP1	Speaker	45P30S
	MIC	EM-80
B1	PC Board	B-394C
B2	PC Board	B-415A

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	MC3357
IC2	IC	BA526
IC3	IC	TC5082P (IC-2E only)
Q1	Transistor	2SC2026
Q2	Transistor	2SC2668-0
Q3	FET	2SK192-Y
Q4	Transistor	2SC2668-0
Q5	Transistor	2SC2668-0
Q6	Transistor	2SA1048-Y
Q7	Transistor	2SC2458-GR
Q8	Transistor	2SC2458-GR
Q9	Transistor	2SA1048-Y
Q10	Transistor	2SC2458-GR
Q11	Transistor	2SA1048-Y
Q12	Transistor	2SC2458-GR
Q13	Transistor	2SA1048-Y
Q14	Transistor	2SC2458-GR
Q15	Transistor	2SC2458-GR
Q16	Transistor	2SB562-C
Q17	FET	2SK192-Y
Q18	Transistor	2SB562-C
Q19	Transistor	2SC2458-GR
Q20	Transistor	2SC2458-GR
Q21	Transistor	2SA1048-Y
Q22	Transistor	2SA1048-Y
Q23	Transistor	2SA1048-Y
Q24	Transistor	2SC2458-GR (IC-2A/AT only)

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
Q25	Transistor	2SC2458-GR
Q26	Transistor	2SC2458-GR
Q27	Transistor	2SA1048-Y
Q28	Transistor	2SC2458-GR
Q29	Transistor	2SC2458-GR
Q30	Transistor	2SC2458-GR (IC-2A/AT only)
Q31	Transistor	2SA1015-Y (IC-2A/AT only)
Q32	Transistor	2SC2458-GR (IC-2A/AT only)
Q33	Transistor	2SA1015-Y (IC-2E only)
D1	Diode	1S1555
D2	Diode	1S1555
D3	Zener	WZ-081
D4	Zener	YZ-045B
D5	Diode	1S1555 (IC-2A/AT only)
D6	Diode	1S1555 (IC-2E only)
FI1	Monolithic Xtal Filter	10M15B9
FI2	Ceramic Filter	CFU455E2
X1	Crystal	10.240MHz HC18/T
X2	Crystal	7.168MHz HC18/T (IC-2E only)
L1	Coil	LS-160
L2	Coil	LS-160
L3	Coil	LS-160
L4	Coil	LS-160
L5	Coil	LS-159
L7	Coil	LS-158
R1	Resistor	10K-J ELR10
R2	Resistor	100K-J ELR10
R3	Resistor	100-J ELR10
R4	Deleted	
R5	Resistor	56-J R10
R6	Resistor	220-J ELR10
R7	Resistor	47K-J ELR10
R8	Resistor	2.7K-J ELR10
R9	Resistor	330K-J ELR10
R10	Resistor	10K-J ELR10
R11	Resistor	1.5K-J ELR10
R12	Resistor	1.5K-J ELR10
R13	Resistor	47K-J ELR10
R14	Resistor	22K-J ELR10
R15	Resistor	1K-J R10
R16	Resistor	330K-J ELR10
R17	Resistor	4.7K-J ELR10
R18	Resistor	5.6K-J ELR10
R19	Resistor	1K-J ELR10
R20	Resistor	2.2K-J ELR10
R22	Resistor	3.3K-J ELR10
R23	Resistor	1K-J ELR10
R24	Resistor	3.3K-J ELR10
R25	Resistor	10K-J ELR10
R26	Resistor	10K-J ELR10

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
R27	Resistor	10K-J ELR10
R28	Resistor	4.7K-J ELR10
R29	Resistor	47-J ELR10
R30	Resistor	68K-J ELR10
R31	Resistor	22K-J ELR10
R32	Resistor	10K-J ELR10
R34	Resistor	15K-J ELR10
R35	Resistor	10K-J ELR10
R36	Resistor	47K-J R10
R37	Resistor	22K-J ELR10
R38	Resistor	22K-J ELR10
R39	Resistor	330-J ELR10
R40	Resistor	3.3K-J ELR10
R41	Resistor	4.7K-J ELR10
R42	Resistor	2.2-J ELR10
R43	Resistor	2.7K-J ELR10
R44	Thermistor	33D28
R45	Resistor	470-J ELR10
R46	Resistor	22K-J ELR10
R47	Resistor	470-J ELR10
R48	Resistor	220K-J ELR10
R49	Resistor	56K-J ELR10
R50	Resistor	330-J ELR10
R51	Resistor	10K-J ELR10
R52	Resistor	33K-J ELR10
R53	Resistor	100K-J ELR10 (IC-2A/AT only)
R54	Resistor	150K-J ELR10 (IC-2A/AT only)
R55	Resistor	2.2K-J ELR10
R56	Resistor	68K-J ELR10
R57	Resistor	120K-J ELR10
R58	Resistor	470-J ELR10
R59	Resistor	4.7K-J ELR10
R60	Resistor	3.3K-J ELR10
R61	Resistor	2.2K-J ELR10
R62	Resistor	10K-J ELR10 (IC-2A/AT) 33K-J ELR10 (IC-2E)
R63	Resistor	33-J ELR10
R64	Resistor	1K-J ELR10
R65	Resistor	2.2K-J ELR10 (IC-2A/AT) 4.7K-J ELR10 (IC-2E)
R66	Resistor	2.2K-J ELR10
R67	Resistor	22K-J ELR10
R68	Resistor	1K-J ELR10
R69	Resistor	82K-J ELR10
R70	Resistor	47K-J ELR10
R71	Trimmer	WHS512A 10K
R75	Resistor	3.9K-J R10 (IC-2A/AT only)
R76	Resistor	10K-J R10 (IC-2A/AT only)
R77	Trimmer	WHS512A 4.7K (IC-2A/AT) WHS512A 10K (IC-2E)
R78	Resistor	47K-J ELR10 (IC-2A/AT only)
R79	Resistor	33K-J ELR10
R80	Resistor	47K-J ELR10
R81	Resistor	1K-J ELR10
R82	Resistor	2.2K-J ELR10
R83	Resistor	22K-J ELR10

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
C1	Ceramic	8P 50V
C2	Ceramic	3P 50V
C3	Ceramic	100P 50V
C4	Ceramic	470P 50V
C5	Ceramic	470P 50V
C6	Ceramic	10P 50V
C7	Ceramic	10P 50V
C8	Ceramic	0.35P 50V
C9	Ceramic	0.35P 50V
C10	Ceramic	8P 50V
C11	Barrier Lay	SS45X1E472M
C12	Barrier Lay	SS45X1E472M
C14	Ceramic	4P 50V
C15	Ceramic	0.001 50V
C16	Barrier Lay	SS45X1E472M
C17	Tantalum	10μF 6.3V
C18	Barrier Lay	SS45X1E472M
C19	Ceramic	0.001 50V
C20	Ceramic	47P 50V
C21	Ceramic	120P 50V
C22	Barrier Lay	0.1μF 12V
C23	Electrolytic	0.1μF 50V AK
C24	Ceramic	10P 50V AK
C25	Barrier Lay	SS45X1E332M
C26	Electrolytic	0.22μF 50V AK
C27	Electrolytic	0.22μF 50V AK
C28	Ceramic	0.001 50V
C29	Ceramic	0.001 50V
C30	Ceramic	0.001 50V
C31	Ceramic	33P 50V
C32	Ceramic	0.001 50V
C33	Electrolytic	4.7μF 35V RC2
C34	Ceramic	470P 50V
C35	Electrolytic	3.3μF 50V RC2
C36	Electrolytic	0.47μF 50V RC2
C37	Electrolytic	1μF 50V RC2
C38	Electrolytic	1μF 50V RC2
C39	Electrolytic	10μF 16V RC2
C40	Ceramic	0.001 50V
C41	Electrolytic	0.47μF 50V RC2
C42	Electrolytic	10μF 16V RC2
C43	Ceramic	0.001 50V
C44	Electrolytic	100μF 10V MS
C45	Electrolytic	47μF 10V MS
C46	Electrolytic	100μF 10V MS
C47	Ceramic	0.001 50V
C48	Electrolytic	47μF 25V MS
C49	Ceramic	470P 50V
C50	Electrolytic	0.22μF 50V AK
C51	Ceramic	470P 50V
C52	Electrolytic	100μF 10V MS
C53	Ceramic	470P 50V
C54	Electrolytic	100μF 10V MS
C55	Electrolytic	10μF 16V RC2
C56	Electrolytic	0.47μF 50V RC2
C57	Electrolytic	10μF 16V RC2
C58	Barrier Lay	SS45X1E103M
C59	Ceramic	470P 50V
C60	Ceramic	470P 50V
C61	Ceramic	470P 50V
C62	Electrolytic	1μF 50V RC2
C63	Ceramic	0.001 50V
C64	Mylar	0.0027 50V
C65	Mylar	0.0047 50V

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
C67	Electrolytic	1μF 50V RC2
C69	Electrolytic	0.1μF 50V AK (IC-2E only)
C70	Barrier Lay	SS45X1E472M
C71	Ceramic	10P 50V (IC-2E only)
C72	Ceramic	10P 50V (IC-2E only)
C73	Ceramic	47P 50V (IC-2E only)
C74	Electrolytic	10μF 16V RC2 (IC-2A/AT only)
C75	Electrolytic	0.47μF 50V RC2 (IC-2A/AT only)
C76	Ceramic	470P 50V (IC-2A/AT only)
S1	Switch	TWN0301
B1	PC Board	B-391C

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	TC9122P
IC2	IC	TC5081P
IC3	IC	TC5082P-GL
Q1	FET	2SK192-Y
Q2	Transistor	2SC2668-0
Q3	Transistor	2SC2668-0
Q4	Transistor	2SC2668-0
Q5	Transistor	2SC945-R
Q6	Transistor	2SC2026
Q7	Transistor	2SC2668-0
Q8	Transistor	2SC2026
Q9	Transistor	2SC2668-0
Q10	Transistor	2SC2458-GR
Q11	Transistor	2SC383TM
Q12	Transistor	2SC2053
Q13	Transistor	2SC1947
Q14	Transistor	2SA1048-Y
D3	Varactor Diode	1SV50
D4	Diode	1SS53
D5	Diode	1S1555
D6	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	1SS53
D10	Diode	1SS53
D11	Diode	1SS53
D12	Diode	1SS53
D13	Diode	1SS53
D14	Diode	1S1555
D15	Diode	1S1209
D16	Diode	1SS53
D17	Diode	1SS53
D18	Diode	1S1555
X1	Crystal	5.12000MHz HC18/T
X2	Crystal	32.32750MHz HC18/T
X3	Crystal	35.00125MHz HC18/T

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
L1	Choke	LR-118
L2	Choke	LR-77
L3	Coil	LB-88
L4	Choke	LW-20
L5	Choke	220 L4
L6	Choke	LR-79
L7	Coil	LB-90
L8	Coil	LB-89
L9	Coil	LB-89
L10	Coil	LB-89
L11	Coil	LB-92
L12	Coil	LB-91
L13	Coil	LB-91
L14	Coil	LB-91
L15	Coil	LS-160
L16	Coil	LS-160
L17	Coil	LS-160
L18	Coil	LS-160
L19	Coil	LS-160
L20	Coil	LS-160
L21	Coil	LS-160
L22	Coil	LS-160
L23	Coil	LA-127
L24	Coil	LA-134
L25	Coil	LA-121
L26	Coil	LA-121
L27	Choke	LR-78
L28	Coil	LA-136
L29	Coil	LA-135
L30	Coil	LA-143
L31	Choke	LR-77
L32	Choke	LR-118
R1	Deleted	
R2	Resistor	47K-J ELR10
R3	Resistor	47K-J ELR10
R4	Resistor	10K-J ELR10
R5	Resistor	470-J R10
R6	Resistor	10K-J ELR10
R7	Resistor	100K-J ELR10
R8	Resistor	4.7K-J ELR10
R9	Resistor	220-J ELR10
R10	Resistor	22K-J ELR10
R11	Resistor	470-J ELR10
R12	Resistor	33K-J ELR10
R13	Resistor	120K-J ELR10
R14	Resistor	2.2K-J ELR10
R15	Resistor	22-J ELR10
R16	Resistor	10K-J ELR10
R17	Resistor	2.2K-J R10
R18	Resistor	220K-J ELR10
R19	Resistor	470-J ELR10
R20	Resistor	47K-J ELR10
R21	Resistor	47K-J ELR10
R22	Resistor	47K-J ELR10
R23	Resistor	2.2K-J ELR10
R24	Resistor	2.2K-J ELR10
R25	Resistor	2.2K-J ELR10
R26	Resistor	2.2K-J ELR10
R27	Resistor	2.2K-J ELR10
R28	Resistor	2.2K-J ELR10
R29	Resistor	2.2K-J ELR10
R30	Resistor	2.2K-J ELR10
R31	Resistor	22K-J ELR10

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
R33	Resistor	1K-J ELR10
R34	Resistor	33K-J ELR10
R35	Resistor	47-J ELR10
R36	Resistoe	4.7K-J ELR10
R37	Resistor	47-J ELR10
R38	Resistor	82K-J ELR10
R39	Resistor	33K-J ELR10
R40	Resistor	82K-J ELR10
R41	Resistor	47-J ELR10
R42	Resistor	10K-J ELR10
R43	Resistor	150-J ELR10
R44	Resistor	470-J ELR10
R45	Resistor	27-J ELR10
R46	Resistor	47-J ELR10
R47	Resistor	47-J ELR10
R48	Resistor	47-J ELR10
R49	Resistor	2.2-J ELR10
R50	Resistor	82-J ELR10
R52	Resistor	22-J ELR10
R53	Resistor	330-J ELR10
R54	Resistor	15K-J ELR10
R55	Deleted	
R56	Resistor	100K-J ELR10
R57	Resistor	2.2K-J ELR10
C1	Ceramic	0.001 50V
C2	Ceramic	0.001 50V
C3	Ceramic	0.001 50V
C4	Ceramic	0.001 50V
C5	Ceramic	0.001 50V
C6	Ceramic	0.001 50V
C7	Ceramic	0.001 50V
C8	Ceramic	0.001 50V
C9	Ceramic	0.001 50V
C10	Ceramic	0.001 50V
C11	Ceramic	0.001 50V
C12	Ceramic	0.001 50V
C13	Tantalum	CS15E1H 2R2M
C14	Barrier Lay	SS45X1E103M
C15	Electrolytic	10μF 16V RC2
C16	Ceramic	3P 50V
C17	Ceramic	470P 50V
C18	Ceramic	470P 50V
C20	Ceramic	51P 50V
C21	Electrolytic	100μF 10V MS
C22	Ceramic	470P 50V
C23	Ceramic	470P 50V
C24	Ceramic	470P 50V
C25	Ceramic	10P 50V (UJ)
C26	Ceramic	1P 50V
C27	Ceramic	33P 50V (UJ)
C28	Ceramic	3P 50V
C29	Ceramic	0.001 50V
C30	Ceramic	0.001 50V
C31	Ceramic	12P 50V
C32	Ceramic	39P 50V
C33	Barrier Lay	SS45X1E472M
C35	Ceramic	33P 50V
C36	Ceramic	0.001 50V
C37	Barrier Lay	SS45X1E472M
C38	Ceramic	0.001 50V
C39	Electrolytic	100μF 10V MS
C40	Barrier Lay	SS45X1E472M
C41	Ceramic	0.001 50V

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
C43	Ceramic	33P 50V
C44	Ceramic	33P 50V
C46	Ceramic	68P 50V
C47	Ceramic	68P 50V
C48	Ceramic	56P 50V
C49	Ceramic	68P 50V
C50	Ceramic	0.001 50V
C51	Ceramic	0.001 50V
C52	Ceramic	56P 50V
C53	Ceramic	22P 50V
C54	Ceramic	56P 50V
C55	Ceramic	0.001 50V
C56	Ceramic	47P 50V
C57	Ceramic	5P 50V
C58	Ceramic	5P 50V
C59	Ceramic	0.001 50V
C60	Ceramic	0.001 50V
C61	Ceramic	47P 50V
C62	Ceramic	12P 50V
C63	Ceramic	0.5P 50V
C64	Ceramic	0.001 50V
C65	Ceramic	12P 50V
C66	Ceramic	0.001 50V
C67	Ceramic	470P 50V
C68	Ceramic	0.001 50V
C69	Electrolytic	4.7μF 35V RC2
C70	Ceramic	10P 50V
C71	Ceramic	0.35P 50V
C72	Ceramic	10P 50V
C73	Ceramic	0.001 50V
C74	Ceramic	470P 50V
C75	Ceramic	47P 50V
C76	Ceramic	470P 50V
C77	Ceramic	10P 50V
C78	Ceramic	0.5P 50V
C79	Ceramic	10P 50V
C80	Ceramic	470P 50V
C81	Ceramic	470P 50V
C82	Ceramic	47P 50V
C83	Ceramic	470P 50V
C84	Ceramic	470P 50V
C85	Trimmer	MCV50D1H200 max20P
C86	Trimmer	MCV50D1H100 max10P
C87	Ceramic	15P 50V
C88	Electrolytic	1μF 50V RC2
C89	Ceramic	470P 50V
C90	Trimmer	MCV50D1H100 max10P
C91	Trimmer	MCV50V1H200 max20P
C92	Ceramic	470P 50V
C93	Ceramic	10P 50V
C94	Ceramic	100P 50V
C95	Ceramic	33P 50V
C96	Ceramic	100P 50V
C97	Ceramic	2P 50V
C98	Ceramic	27P 50V
C100	Ceramic	470P 50V
C102	Electrolytic	0.47μF 50V RC2
S1	Switch	HSW0567-01-310
S2	Switch	HSW0567-01-310
S3	Switch	HSW0567-01-310
B1	PC Board	B-390D

AC BATTERY CHARGER

BC-30

MAINTENANCE MANUAL

SPECIFICATIONS

Applicable Battery Packs	IC-BP2, IC-BP3, IC-BP5 IC-BP4 (applies only with Nickel-Cadmium batteries inserted)
Number of Semiconductors	Transistor 9 IC 2 Diode 12
Power Supply Requirement	100/117/230V AC 50/60Hz (Input voltage can be selected by changing internal wiring.)
Charging Current	600mA for IC-BP2 and IC-BP5 25mA for IC-BP3 45mA for IC-BP4 (Nickel-Cadmium inserted)
Usable Temperature	0°C ~ +45°C for IC-BP3 and IC-BP4 +10°C ~ 40°C for IC-BP2 and IC-BP5
Dimensions	72mm(H) x 172mm(W) x 104mm(D)
Weight	Approx. 1.0kg

DESCRIPTION OF CONTROLS

1. Power Switch
   When the charger is connected to a wall outlet, it turns the charger on.

2. Power Lamp
   Indicates power is on.

3. Charge lamp
   Indicates charging is underway, goes out then charging of rapid-charge packs is completed.

4. Insertion slot for battery packs.

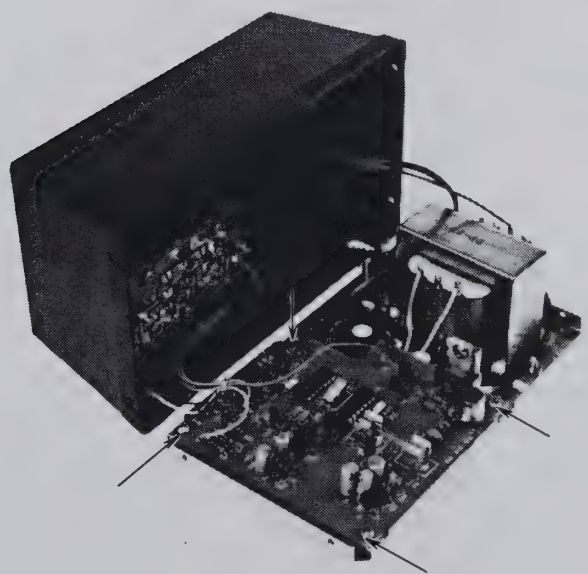
5. Charging terminal
   Correspond to the terminals on the bottom of the battery packs.

6. Microswitches.
   Since the current and capacity for each battery pack is different, these microswitches select the proper factors for each one.

DISASSEMBLING

1. Remove the four screws which have retained the cover of the unit as shown in the figure.

2. Remove the cover from the chassis with taking care to donot make damage to the internal wirings as shown. When you wish to remove the PC Board, remove the four screws at each end of the board as shown in the figure.



CIRCUIT DESCRIPTION

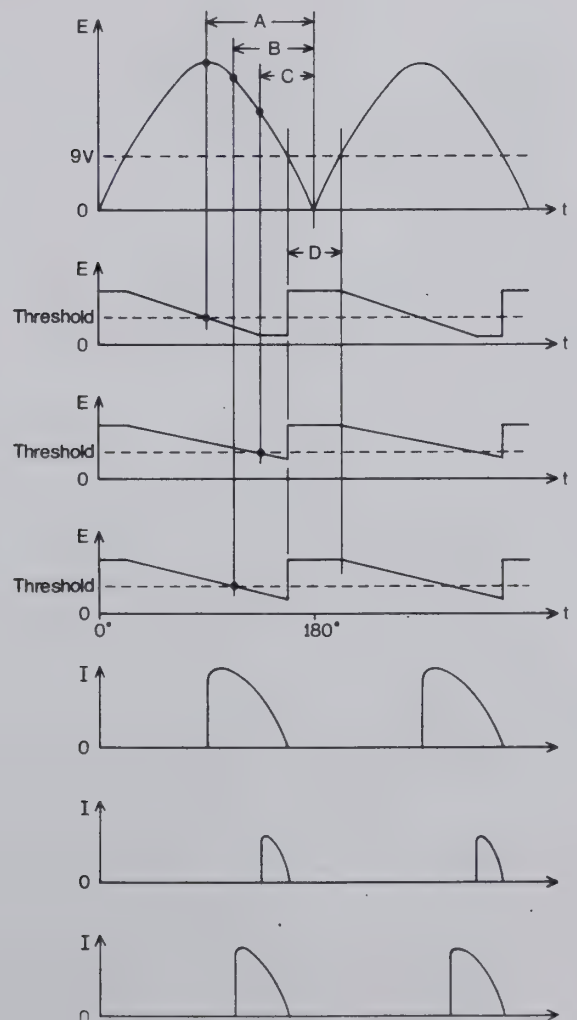
This charger provides proper charging current for various battery packs which is selected by charging current selector on the bottom of the battery pack.
Also a constant charging current is provided by controlling conducting phase angle of the SCR in the circuit. It keeps the current constant even if various battery packs which have different output voltage, has been used.

1. CONDUCTING ANGLE CONTROL CIRCUIT

A gate pulse is used to control the thyristor (SCR) in the circuit. This gate pulse is a part of a full-wave rectified wave and its phase angle is controlled by a saw tooth pulse which is synchronized to the full-wave rectified wave.

The pulse falltime of the saw tooth pulse is controlled by an actual charging current, and it decides the phase angle of the gate pulse of between 40 degrees and 160 degrees.

The saw tooth pulse generate circuit consists of Q2, Q5 and C9.
A full-wave rectified voltage is applied to the base of Q2 through R4 and turns Q2 on at near its base line (D portion in the figure), and charges C9 to +9V which from regulator Q1. When the rectified voltage exceeds +9V (out of D portion), Q2 is turned off and the charged voltage of C9 is discharged through Q5, and a saw tooth wave is generated across C9. This saw tooth pulse is fed to Pin 12 of IC2.



When the pulse voltage decreases less than gate's threshold voltage, Pin 11 of IC2 puts out H level voltage. This turns Q4 and Q3 on, and a portion of full-wave rectified voltage is fed to the gate of D6 SCR through Q3, and D6 is turned on.

When the SCR has been turned on, it holds this condition until the power source voltage becomes zero or its cathode is biased by reverse voltage. Thus, when the full-wave rectified voltage becomes less than +9V (D portion in the figure), the SCR will be turned off.

Rated charging current is decided by R37 ~ R42. R37 ~ R42 are selected by S3 ~ S5 which are turned on or off by a battery pack's charging current selector, and are in series with the charging battery.

A voltage across R37, R38 or R39 ~ R42 is integrated by R14 and C16, then fed to the base of Q6. Q5 and Q6 compose a differential amplifier. A reference voltage which is divided from +9V by R11 and R12, is applied to the base of Q5, thus the collector current of Q5 is varied by the base voltage of Q6, and controls discharging time of C9.

For example, when the charging current increases more than the specified charging current, Q6 collector current increases, Q5 collector current decreases, C9 discharging time becomes longer, the phase angle of D6 gate pulse delays (the pulse width becomes narrower), and the charging current decreases.

When the charging current decreases less than the specified charging current, the circuit functions the opposite way and keeps the charging current constant.

2. LOGIC CIRCUIT

The logic circuit is controlled by the charging current select switches S3 ~ S5, and the charging detector Q10.
When charging IC-BP2 or IC-BP5, S5 is turned on by the charging current selector on the battery pack.

The charging current (600mA) flows through R39 ~ R42, and a voltage across these resistors is applied to the base of Q10 and turns it on. Thus, a gate input Pin 1 and 2 of IC2 becomes L level, its output Pin 3 H level. This puts out H level at Pin 4 of IC1, output of a flip-flop consisting of a gate of IC1 and a gate of IC2. Also Pin 10 of IC1 puts out H level and Pin 10 of IC2 L level.

This grounds the emitter of Q4 through R10 and Pin 10 of IC2, and Q3 is turned on during Pin 11 of IC2 is H level and charges the battery pack.

When the battery pack is fully charged, the built-in thermal switch in the pack is turned off and cuts off the ⊖ charging terminal. Thus, H level is applied to Pin 1 and 2 of IC2, Pin 5 of IC1 and the flip-flop is turned to reverse condition and Pin 4 of IC1 becomes L level. This puts out H level at Pin 10 of IC2 and turns Q4 off, and any charging current does not flow even if the thermal switch has been turned on when the battery pack is cooled.

When the battery pack is removed from the charger, S5 is turned off and Pin 5 of IC1 is grounded through S5. This resets the flip-flop for another charging.

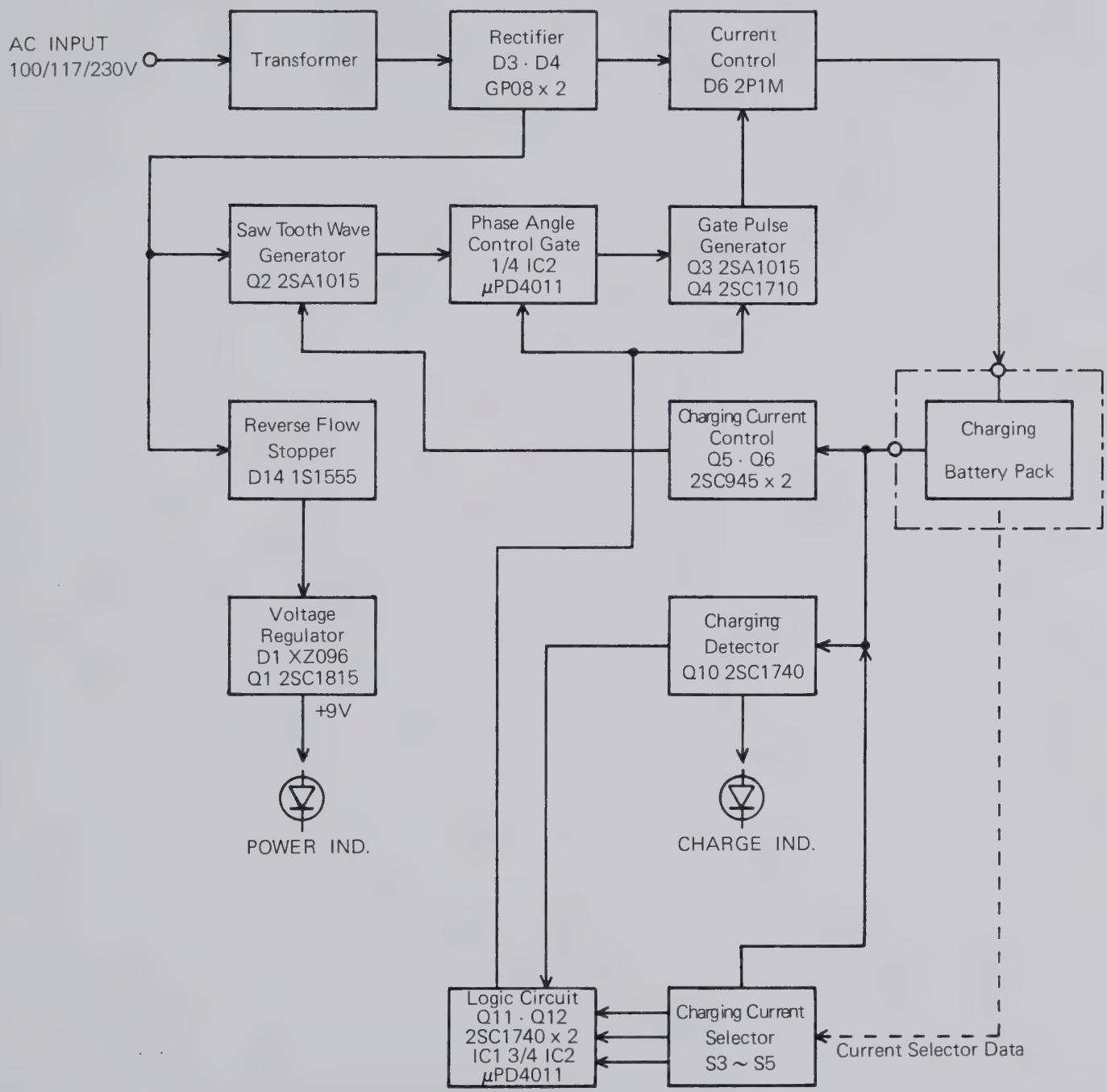
When charging IC-BP3, S3 is turned on and the charging current (25mA) flows through R37.
Pin 5 and 8 of IC1 are grounded through S5, Pin 10 of IC2 is L level and Q4 emitter is grounded through R10. Thus, the charging current flows until the battery pack is removed from the charger.

When charging IC-BP4 inserted nickel-cadmium batteries S4 is turned on and the charging current (45mA) flows through R38. The logic circuit works the same as charging IC-BP3.

SPECIFICATIONS OF BATTERY PACKS

	IC-BP2	IC-BP3	IC-BP4	IC-BP4	IC-BP5
Cells [Capacity]	N-425A R (X 6) [400mAH]	N-250A A (X 7) [250mAH]	AA Size Alkaline (X 6)	AA Size Nickel-Cadmium (X 6)	N-425A R (X 9) [400mAH]
Voltage	7.2V	8.4V	9.0V	7.2V	10.8V
RF Output	1.0W	1.5W	1.5W	1.0W	2.3W
Charging	Rapid	Normal		Normal	Rapid
Charging Time	1～1.5H	15H		15H	1～1.5H
Suitable Charger	BC–30	BC–30 BC-25U IC–CP1		BC–30	BC–30
Charging Current	600mA	25mA		45mA	600mA
Ambient Temperature	+10°～+40°C	0°～+45°C		0°～+45°C	+10°～+40°C
Overcharge Protect	○	X		X	○
Current Selector					
Height	39m/m	39m/m	49m/m	49m/m	60m/m
Battery Replace	X	X	○	○	X

BLOCK DIAGRAM



VOLTAGE CHART

TRANSISTOR

Note: Measuring instrument is a 50KΩ/V multimeter.

BATTERY	No connection			IC-BP3(25mA)			IC-BP4 (45mA)			IC-BP2/BP5 (600mA)		
Tr. NO.	BASE	COLLE-CTOR	EMI TTER	BASE	COLLE-CTOR	EMI TTER	BASE	COLLE-CTOR	EMI TTER	BASE	COLLE-CTOR	EMI TTER
Q 1	9.8	18.0	9.2	9.8	14.5	9.1	9.8	14.5	9.2	9.8	13.0/20.0	9.2
Q 2	9.4	2.9	9.2	9.4	6.2	9.1	9.4	6.2	9.2	9.4	5.2/4.4	9.2
Q 3	16.5	15.0	17.0	16.0	2.7	3.2	16.0	2.4	2.6	14.0	5.0/7.8	14.0
Q 4	9.1	16.5	8.5	1.75	16.0	1.65	1.6	16.0	1.7	3.6/4.8	14.0	3.3/4.4
Q 5	0.9	2.4	0.32	1.0	6.0	0.45	1.0	6.2	0.45	1.0	4.9/3.9	0.44/0.42
Q 6	0.7	9.2	0.32	1.05	9.1	0.45	1.0	9.2	0.45	1.0	9.1	0.44/0.42
Q10	0	7.6	GND	0.75	0.1	GND	0.74	0.1	GND	0.75	0.1	GND
Q11	0	9.0	GND	0.65	0.1	GND	0.65	0.1	GND	0	8.9	GND
Q12	0	9.0	GND	0	9.0	GND	0	9.0	GND	0.65	0.1	GND

IC

IC NO.	Condition	PIN NO.													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC1	—	9.0	9.0	0	9.0	0	0	GND	0	0	9.0	0	9.0	9.0	9.0
	25mA	0	0	9.0	9.0	0	0	GND	0	9.0	9.0	9.0	0	9.0	9.0
	45mA	0	0	9.0	9.0	0	0	GND	0	9.0	9.0	9.0	0	9.0	9.0
	600mA	9.0	9.0	0	9.0	9.0	0	GND	9.0	0	9.0	9.0	9.0	0	9.0
	CUT	9.0	9.0	0	0	9.0	9.0	GND	9.0	0	9.0	9.0	9.0	0	9.0
IC2	—	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	9.0	2.5	0	9.0
	25mA	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	*1.0	*6.0	9.0	9.0
	45mA	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	*1.0	*5.0	9.0	9.0
	600mA	0.8	0.8	9.0	0	9.0	9.0	GND	9.0	9.0	0	*3.5	*5.0	9.0	9.0
	CUT	4.3	4.3	0	9.0	0	0	GND	0	9.0	9.0	6.0	4.2	9.0	9.0

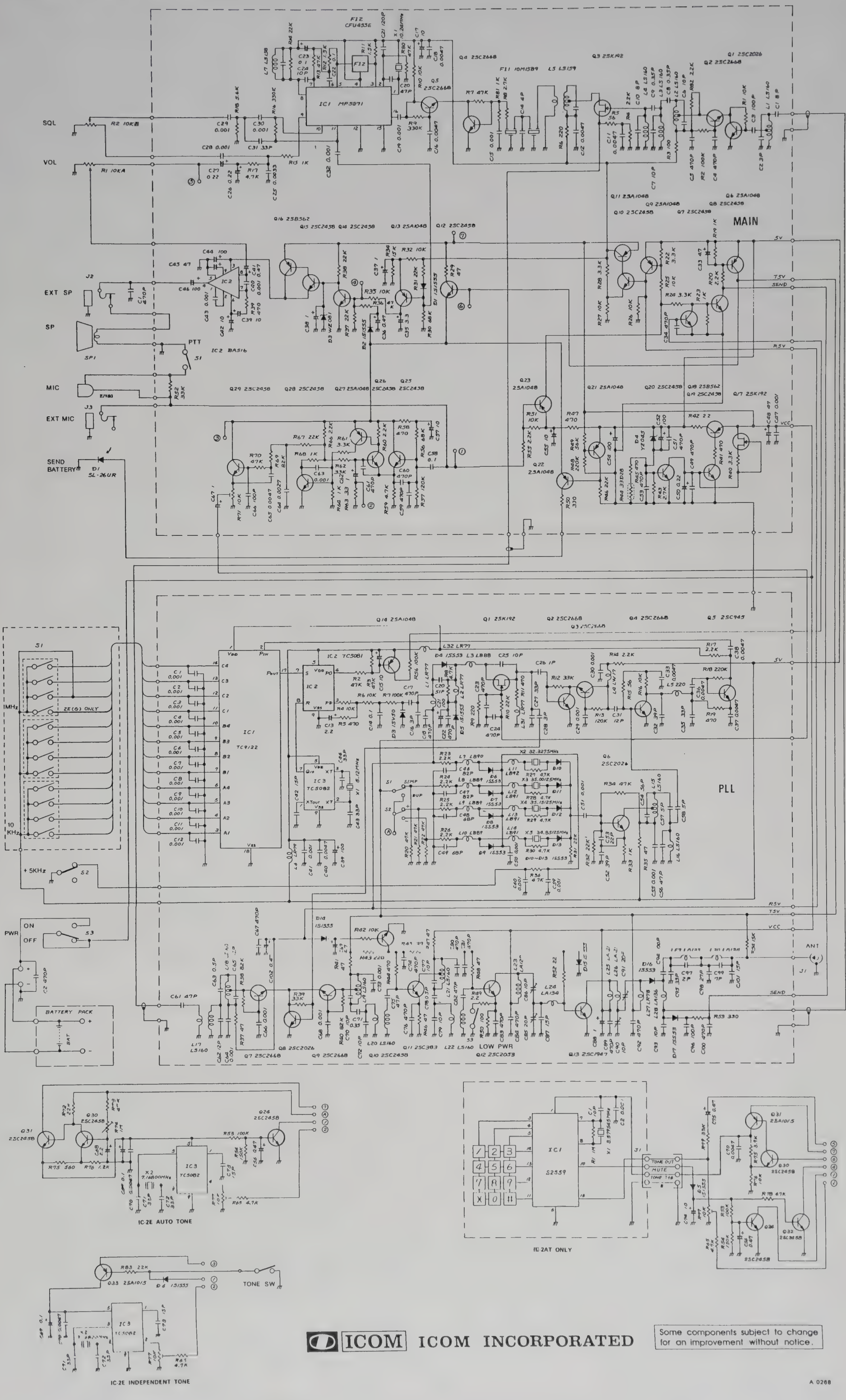
*Will be varied by battery voltage and/or charging conditions.

PARTS LIST

REF. NO.	DESCRIPTION		
IC1	IC μPD4011		
IC2	IC μPD4011		
Q1	Transistor	2SC1815-O, Y, GL, BL	
Q2	Transistor	2SA1015-Y	
Q3	Transistor	2SA1015-Y	
Q4	Transistor	2SC1740-Q, R, S, E	
Q5	Transistor	2SC945-P	
Q6	Transistor	2SC945-P	
Q10	Transistor	2SC1740-Q, R, S, E	
Q11	Transistor	2SC1740-Q, R, S, E	
Q12	Transistor	2SC1740-Q, R, S, E	
D1	Zener	XZ-096	
D2	Diode	1S1555	
D3	Diode	GP-08B	
D4	Diode	GP-08B	
D5	Diode	1S1555	
D6	SCR	2P1M	
D9	Diode	GP-08B	
D10	Diode	1S1555	
D11	Diode	1S1555	
D12	LED	LD-002R	
D14	Diode	1S1555	
L1	Choke	LW-16	
L2	Choke	LW-9	
L3	Choke	LW-9	
R1	Resistor	820	ELR25
R2	Resistor	220	ELR25
R3	Resistor	33	ELR25
R4	Resistor	22K	ELR25
R5	Resistor	2.2K	ELR25
R6	Resistor	3.3K	ELR25
R7	Resistor	1K	R25
R8	Resistor	10K	R25
R9	Resistor	1K	ELR25
R10	Resistor	47K	R25
R11	Resistor	22K	ELR25
R12	Resistor	2.7K	ELR25
R13	Resistor	1.5K	ELR25
R14	Resistor	22K	ELR25
R15	Resistor	15K	ELR25
R16	Resistor	680	ELR25
R17	Resistor	820	ELR25
R23	Resistor	10K	ELR25
R24	Resistor	100K	ELR25
R25	Resistor	10K	ELR25
R26	Resistor	100K	ELR25
R27	Resistor	10K	ELR25
R28	Resistor	100K	ELR25

REF. NO.	DESCRIPTION		
R29	Resistor	100K	R25
R30	Resistor	5.6K	R25
R31	Resistor	470K	R25
R32	Resistor	22K	R25
R33	Resistor	680	R25
R34	Resistor	680	R25
R35	Resistor	10K	ELR25
R36	Resistor	10K	ELR25
R37	Resistor	27	R25
R38	Resistor	15	R25
R39	Resistor	1	R25
R40	Resistor	1	R25
R41	Resistor	1	R25
R42	Resistor	1	R25
C1	Electrolytic	47μF/25V	
C2	Electrolytic	10μF/16V	
C3	Ceramic	470P	
C4	Electrolytic	100μF/10V	
C5	Ceramic	0.0047	
C6	Ceramic	0.0047	
C7	Ceramic	0.0047	
C8	Ceramic	470P	
C9	Barrier Lay	0.047	
C10	Ceramic	470P	
C11	Ceramic	470P	
C13	Ceramic	470P	
C14	Ceramic	470P	
C15	Ceramic	470P	
C16	Electrolytic	47μF	10V
C19	Electrolytic	22μ	16V
C20	Ceramic	470P	
C21	Ceramic	470P	
C22	Electrolytic	2.2μ	50V
S1	Switch	SDJ2S	
S3	Switch	D2MS	
S4	Switch	D2MS	
S5	Switch	D2MS	
	PC Board	B-439B	
	HEATSINK	41912	
	Fuse Holder	S-N5051	
	Fuse	2A	
T1	Transformer	TP-25	
	Power Cord	OPC-013	

IC-2A/AT/E SCHEMATIC DIAGRAM



ICOM ICOM INCORPORATED

Some components subject to change for an improvement without notice.

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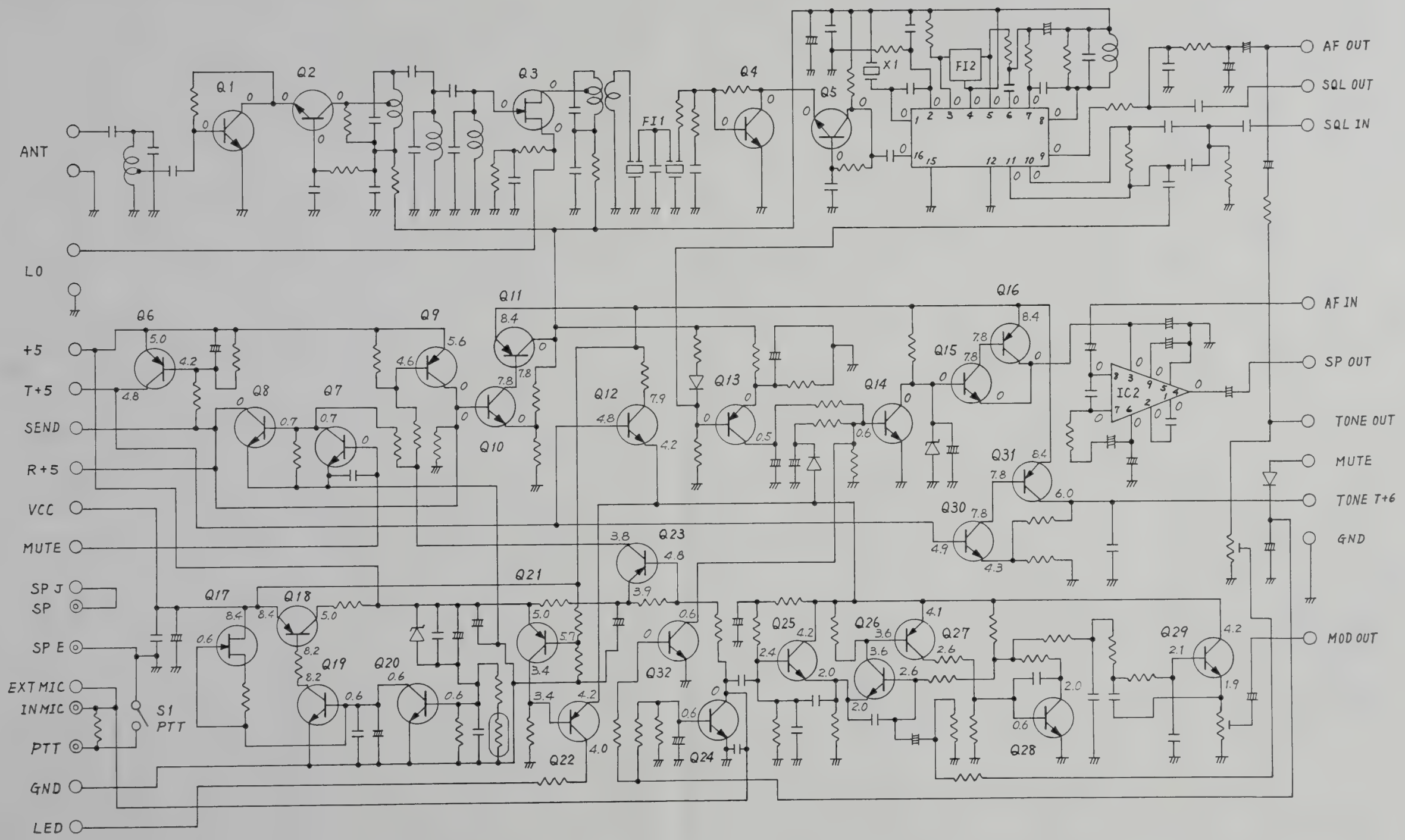
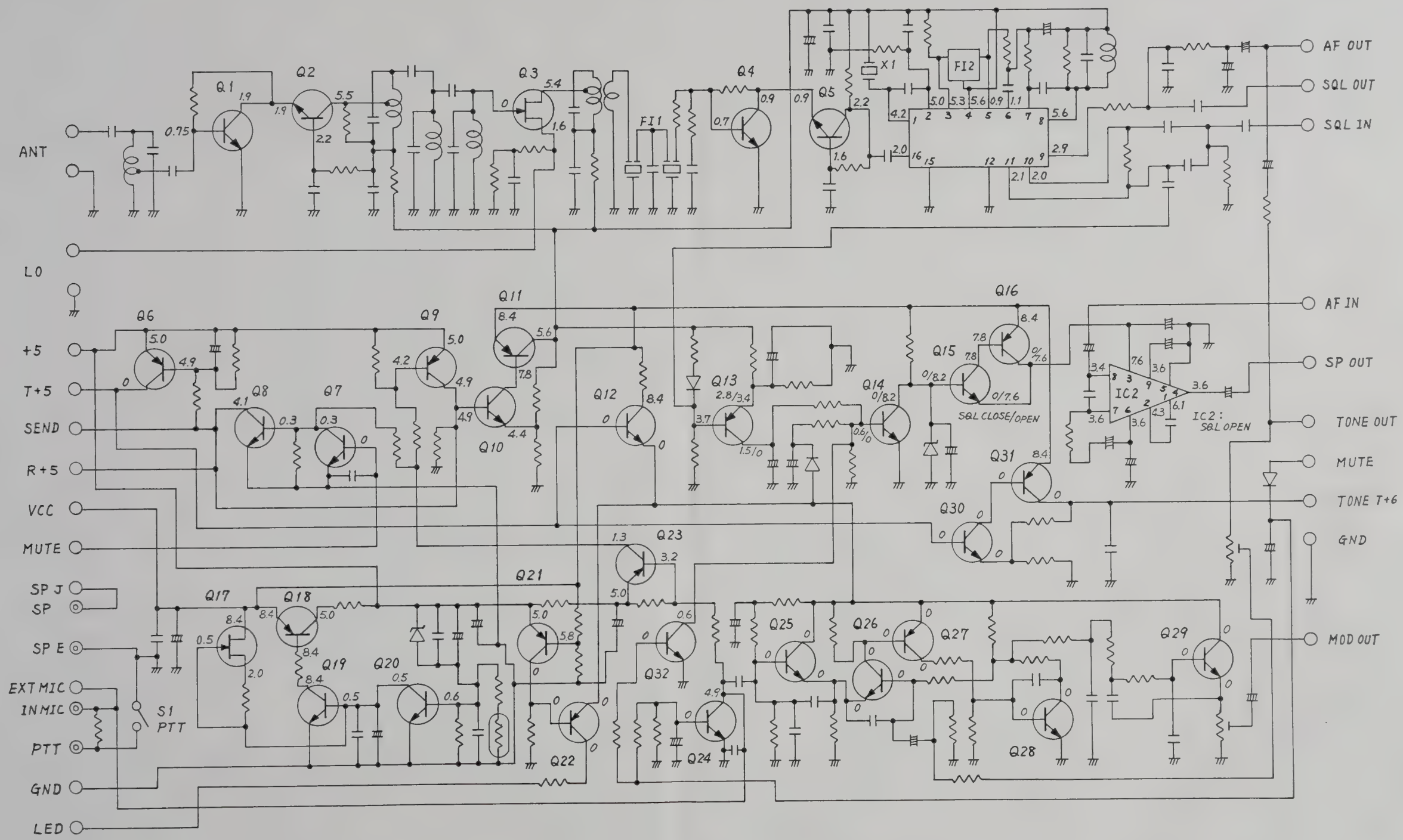
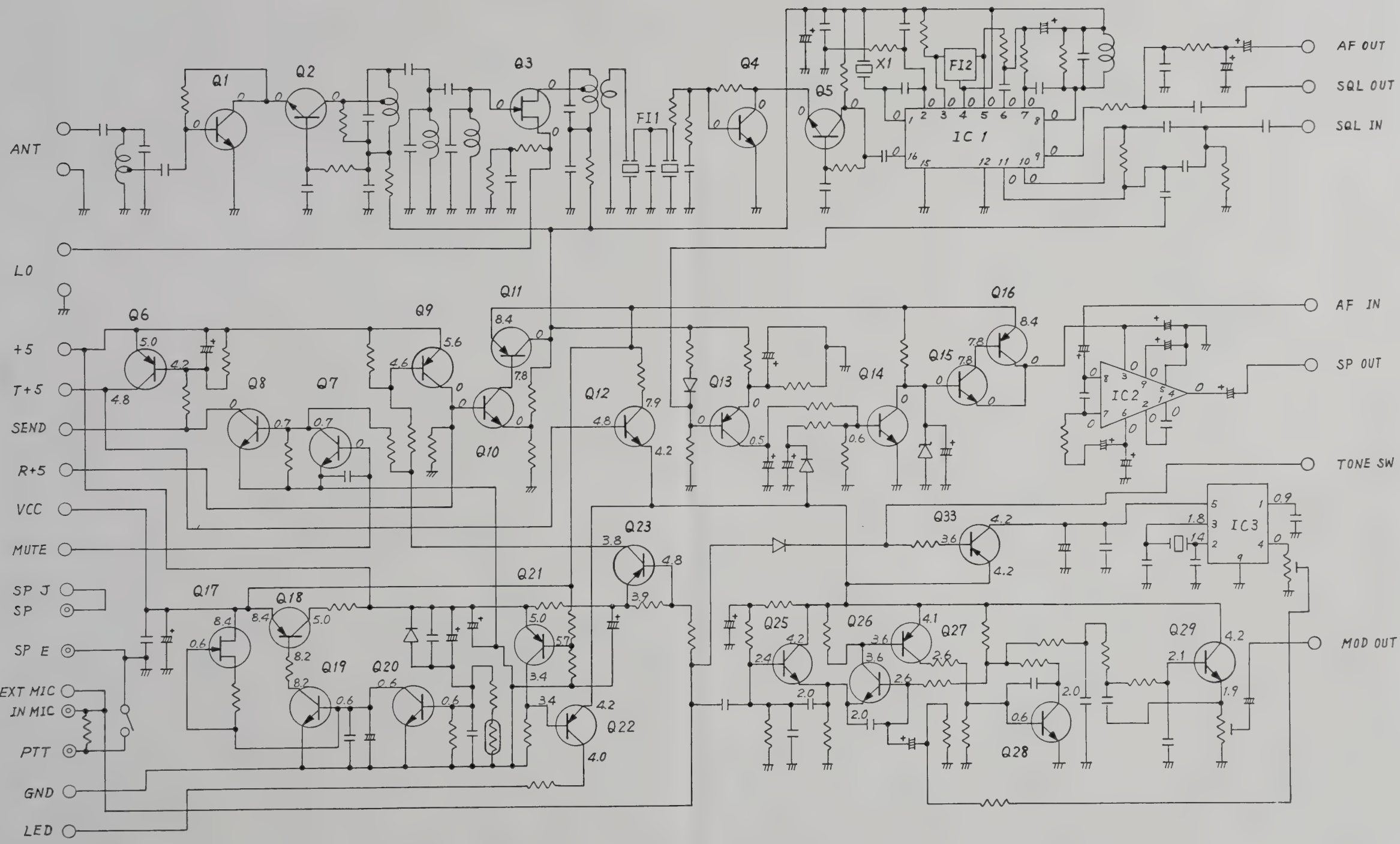
IC-2A MAIN UNIT VOLTAGE CHART (TRANSMIT)



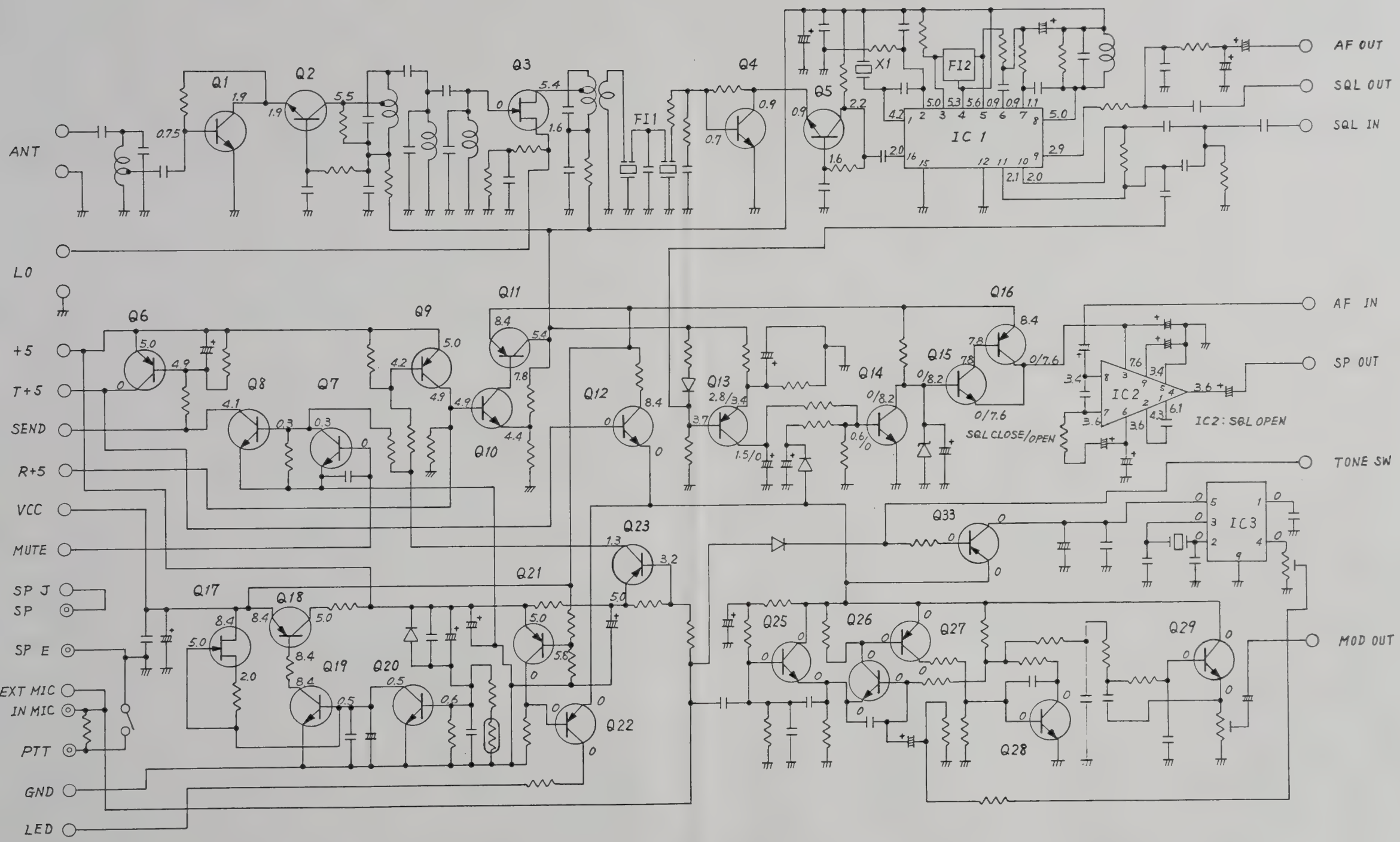
IC-2A MAIN UNIT VOLTAGE CHART (TRANSMIT)



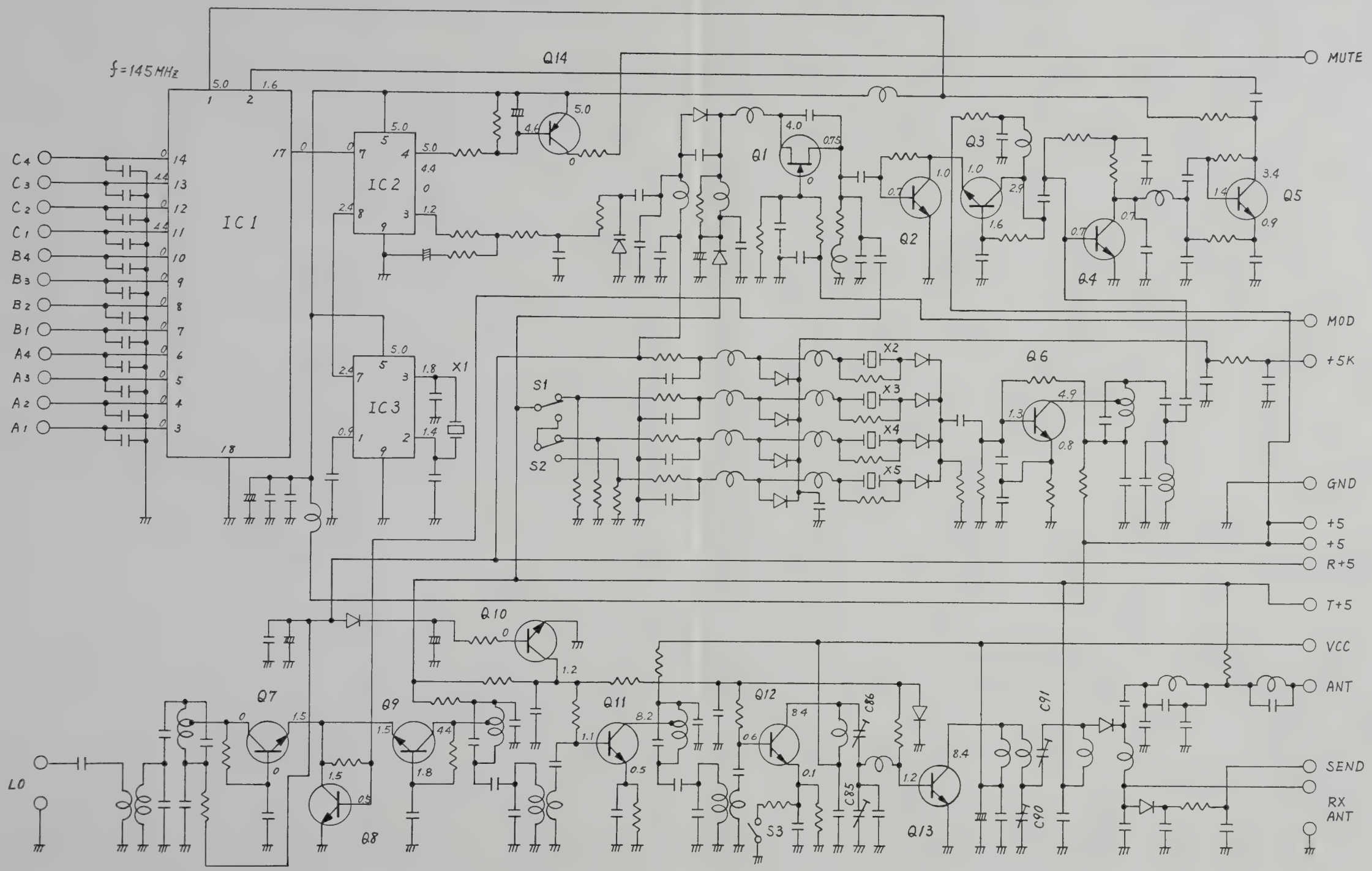
IC-2E MAIN UNIT VOLTAGE CHART (TRANSMIT)



IC-2E MAIN UNIT VOLTAGE CHART (RECEIVE)



PLL UNIT VOLTAGE CHART (TRANSMIT)



PLL UNIT VOLTAGE CHART (RECEIVE)